Final Report

Air Quality Monitoring in the Bow Corridor

December 1999 to August 2001

Alberta
ENVIRONMENT

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Air Quality Monitoring in the Bow Corridor
Final Report – December 1999 to August 2001

Summary

With the increasing population and tourist use of the Bow Corridor over the past decade, air quality has become an important environmental issue in the region. Some of the important air quality issues in the Bow Corridor are (1) particulate emissions from industrial, natural and domestic sources; and (2) air pollution from traffic along Highway #1 and in communities in the Bow Corridor.

Alberta Environment monitored air quality in the Bow Corridor and the Cochrane area from December 1999 to August 2001. Monitoring took place in and near the communities of Cochrane, Exshaw, Canmore and Banff and also near industrial facilities in the Cochrane and Exshaw areas. The monitoring survey was made up of three components.

(1) The *Mobile Air Monitoring Laboratory* (MAML) was used to monitor air quality at 22 sites in the Cochrane, Exshaw, Canmore and Banff areas. This unit monitored for major air quality parameters including sulphur dioxide, particulates, oxides of nitrogen, ozone, hydrocarbons, carbon monoxide, hydrogen sulphide and ammonia using continuous analyzers. A total of 70 hours of data were collected on 14 days from December 1999 to September 2000 by the MAML.
(2) A stationary particulate sampler was set up in Exshaw from July 2000 to August 2001. This sampler monitored for very small, respirable particulates ($PM_{2.5}$) from July 12, 2000 to July 3, 2001 and for larger, inhalable particulates (PM_{10}) from July 3 to August 31, 2001. Weather parameters such as wind, temperature and relative humidity were also monitored in Exshaw from July 2000 to August 2001.
(3) A passive (no power required) air quality monitoring network was set up in the area from Bow Valley Provincial Park to Canmore to collect monthly samples of sulphur dioxide, nitrogen dioxide and ozone. The network consisted of seven sulphur dioxide sites and eleven nitrogen dioxide and ozone sites. Monthly air quality samples were collected at these sites over the one-year period from July 2000 to June 2001.

Results and Conclusions

Ambient levels of all air quality parameters measured by the MAML were below Alberta's Ambient Air Quality Guidelines. Alberta has one-hour air quality guidelines for sulphur dioxide, nitrogen dioxide, ozone, carbon monoxide, hydrogen sulphide and ammonia. These guidelines are some of the most stringent in North America. Maximum one-hour concentrations were:

- 53% of the one-hour guideline for sulphur dioxide,
- 15% of the one-hour guideline for nitrogen dioxide,
- 68% of the one-hour guideline for ozone,
- 8% of the one-hour guideline for carbon monoxide,
- 20% of the one-hour guideline for hydrogen sulphide, and
- 2% of the one-hour guideline for ammonia.

Concentrations of air pollutants emitted by automobiles were low in the Bow Corridor. The maximum one-hour carbon monoxide and nitrogen dioxide levels measured during the survey were 1.1 and 0.031 parts per million (ppm), respectively. These values are much lower than the one-hour guidelines of 13.0 and 0.212 ppm for carbon monoxide and nitrogen dioxide, respectively. The overall average nitrogen dioxide concentration from July 2000 to June 2001 for the passive monitoring network was 0.011 ppm. This is in the range of average values measured over the same time period in Fort McMurray, Fort Saskatchewan and Red Deer (0.009 to 0.013 ppm) and much lower than average values measured in downtown Calgary (0.026 ppm) and Edmonton (0.024 ppm) from July 2000 to June 2001.

Small respirable particulates ($PM_{2.5}$) were collected in Exshaw for 307 days from July 2000 to June 2001. Levels of $PM_{2.5}$ were below the 24-hour Canada-wide Standard (CWS) benchmark concentration on all but one day. A 24-hour $PM_{2.5}$ concentration of 32 micrograms per cubic metre ($\mu g/m^3$) was measured on August 18, 2000 at the Exshaw station. This value is just slightly higher than the 24-hour CWS benchmark concentration of 30 $\mu g/m^3$. $PM_{2.5}$ refers to particles that are less than 2.5 micrometres in diameter (a human hair is about 100 micrometres in diameter) that can be deposited into the lungs and, depending on their composition, may be a human health concern.

Larger, inhalable particulates (PM_{10}) were measured in Exshaw for 59 days from July 3 to August 31, 2001. Levels were higher than at most other locations in Alberta. The average PM_{10} concentration measured in Exshaw over this time period was 47 $\mu g/m^3$ compared to average values of 25 $\mu g/m^3$ measured in both Edmonton and Calgary over the same time period. Elevated PM_{10} levels measured from August 11 to August 22, 2001 were primarily attributed to smoke from forest fires in the Kootenay National Park area. Other sources of larger particulates in the Exshaw area and in the Bow Corridor include local industrial activities, natural wind-blown dust, vehicle exhaust emissions and smoke from recreational wood burning. PM_{10} are particles less then ten micrometres in diameter and can be inhaled into the nose and throat.

Sulphur dioxide levels from the passive network were highest at the site located in Exshaw (at the east end of Heart Mountain Drive). The maximum monthly and 12-month average sulphur dioxide concentrations measured at this site were 0.008 and 0.004 ppm, respectively. Both the monthly and 12-month average values were lower than the 12-month guideline for sulphur dioxide of 0.011 ppm.

Ozone levels from the passive network were similar to other locations in Alberta. The overall 12-month average concentration for the network was 0.021 ppm. This value is close to those observed in Red Deer, Fort Saskatchewan and Fort McMurray (0.018 to 0.022 ppm) and lower than those measured at rural, background stations in Alberta (0.028 to 0.045 ppm) for the same time period. Ozone levels during this time period were lower in Edmonton and Calgary due to destruction of naturally generated ozone by pollutants emitted by automobiles.

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Abbreviations

CH_4	methane
CO	carbon monoxide
H_2S	hydrogen sulphide
km/h	kilometres per hour
MAML	Mobile Air Monitoring Laboratory
NH_3	ammonia
ng/m^3	nanograms per cubic metre of air
NO	nitric oxide
NO_X	total oxides of nitrogen
NO_2	nitrogen dioxide
O_3	ozone
PAHs	polycyclic aromatic hydrocarbons
ppb	parts per billion by volume
ppm	parts per million by volume
$PM_{2.5}$	particulates less than 2.5 micrometres in diameter (respirable particulates)
PM_{10}	particulates less than 10 micrometres in diameter (inhalable particulates)
PSD	passive sampling device
RH	relative humidity
RHC	reactive hydrocarbons
SIA	Strathcona Industrial Association
SO_2	sulphur dioxide
Temp.	temperature
THC	total hydrocarbons
TRS	total reduced sulphur
TSP	total suspended particulates
WBEA	Wood Buffalo Environmental Association
WCAS	West Central Airshed Society
WDR	wind direction
WSP	wind speed
$\mu g/m^3$	micrograms per cubic metre of air

Introduction

An air quality monitoring survey was conducted in the Bow Corridor and the Cochrane area from December 1999 to June 2001. The survey was initiated in response to public concerns about air quality in the Bow Corridor.

The objectives of the survey were to:

(1) measure air pollutant levels in the region.
(2) compare air quality levels to Alberta's Ambient Air Quality Guidelines.
(3) compare air quality levels in the Bow Corridor to other locations in Alberta.

Monitoring was conducted in a broad area from Cochrane to Banff including the communities of Cochrane, Exshaw, Canmore and Banff. Monitoring was also conducted downwind of industrial facilities in the Cochrane and Exshaw areas. Three types of monitoring were used to assess air quality in the survey area.

The Alberta Environment *Mobile Air Monitoring Laboratory* (MAML) was used to monitor air quality in the Bow Corridor and Cochrane area. Parameters measured by the MAML included sulphur dioxide, particulates, oxides of nitrogen, ozone, carbon monoxide, hydrocarbons, hydrogen sulphide, total reduced sulphur and ammonia.

The MAML monitored in the Bow Corridor and Cochrane area for 14 days between December 1999 and September 2000. Alberta Environment routinely conducts unannounced monitoring surveys using the MAML. In 2000, Alberta Environment conducted ten mobile monitoring surveys within the province.
In addition to using the MAML, a stationary particulate monitoring instrument was set up in Exshaw. This instrument was configured to monitor for very small, respirable particulates ($PM_{2.5}$) from July 12, 2000 to July 3, 2001 and larger, inhalable particulates (PM_{10}) from July 3 and August 31, 2001. $PM_{2.5}$ includes particles that are less than 2.5 micrometres in diameter and are small enough to be inhaled into the lungs. PM_{10} are particles less than 10 micrometres in diameter and, generally speaking, can be inhaled into the nose and throat (a human hair is about 100 micrometres in diameter). Weather monitoring equipment consisting of wind, temperature and relative humidity was also set up at the Exshaw station. Particulates and weather data were collected at this location from July 2000 to August 2001. These parameters were monitored on a continuous basis and hourly averaged information is presented in this report.

Air quality monitoring was also conducted for sulphur dioxide, nitrogen dioxide and ozone using passive methods. Since passive monitoring does not require power, air samples can be collected at a number of sites for an extended period of time. In the Bow Corridor survey, passive monitoring techniques were used to monitor sulphur dioxide at seven sites, nitrogen dioxide at eleven sites and ozone at eleven sites. These samples were collected on a monthly basis for 12 months, from July 2000 to June 2001.

This report presents the results of the monitoring survey in three parts. These are:

Part 1: Monitoring Using the Mobile Air Monitoring Laboratory
Part 2: Particulate Monitoring in Exshaw
Part 3: Passive Monitoring for Sulphur Dioxide, Nitrogen Dioxide and Ozone

Part 1: Monitoring Using the Mobile Air Monitoring Laboratory

Alberta Environment used the *Mobile Air Monitoring Laboratory* (MAML) to monitor air quality for 70 hours in the Bow Corridor from between December 1999 and September 2000. The majority of the monitoring was conducted in and near the communities of Exshaw and Canmore. A total of 31 hours of data was collected in and around Exshaw and 24 hours of data was collected in the Canmore area. Additional monitoring was also conducted in Banff (six hours) and Cochrane (nine hours). Air quality was monitored on the following dates representing the winter, spring, summer (including the August long-weekend) and fall seasons.

- Winter (December 15, 16 and 17, 1999).
- Spring (March 21, 22 and 23, 2000).
- Summer (July 11 and 12, 2000 and during the long-weekend on August 5, 6,7 and 8, 2000).
- Fall (September 26 and 27, 2000).

The MAML monitored air quality at 22 sites in the Bow Corridor and Cochrane area. These sites were located in and near Exshaw (seven sites), Canmore (six sites), Cochrane (five sites) and Banff (four sites). The monitoring sites are indicated in Figures 1.2 to 1.5 and Table 1.1. Monitoring was conducted for a minimum of one hour at each location to allow comparison with Alberta's Ambient Air Quality Guidelines.

The initial monitoring sites were selected based on consultation with regional staff from Alberta Environment. Monitoring locations were reviewed as the survey progressed and modified based on concerns indicated through public complaints or observations by the MAML operators.

The Mobile Air Monitoring Laboratory

The MAML is a 27-foot (8.2 m) vehicle that has been specially designed and equipped to measure air quality. It houses a variety of instruments that continuously sample the air at specified time or distance intervals. The MAML is equipped with:

- a dual computer system custom-programmed to accept and record the measurement of air samples from each analyzer.
- a GPS (Global Positioning System) that identifies the MAML's location as it moves around Alberta.
- an exhaust purifying system that minimizes emissions from the vehicle.
- two on-board generators that are also equipped with exhaust scrubbers.

The parameters measured by the MAML during the Bow Corridor survey are indicated in Table 1.2. Air quality parameter concentrations, weather conditions and the MAML operator's comments for each location monitored are indicated in Appendix A of this report. Appendix A also contains median and maximum air parameter concentrations at all sites during the survey and typical median and maximum air parameter concentrations at other locations in Alberta.

Figure 1.1 Alberta Environment's Mobile Air Monitoring Laboratory (MAML).

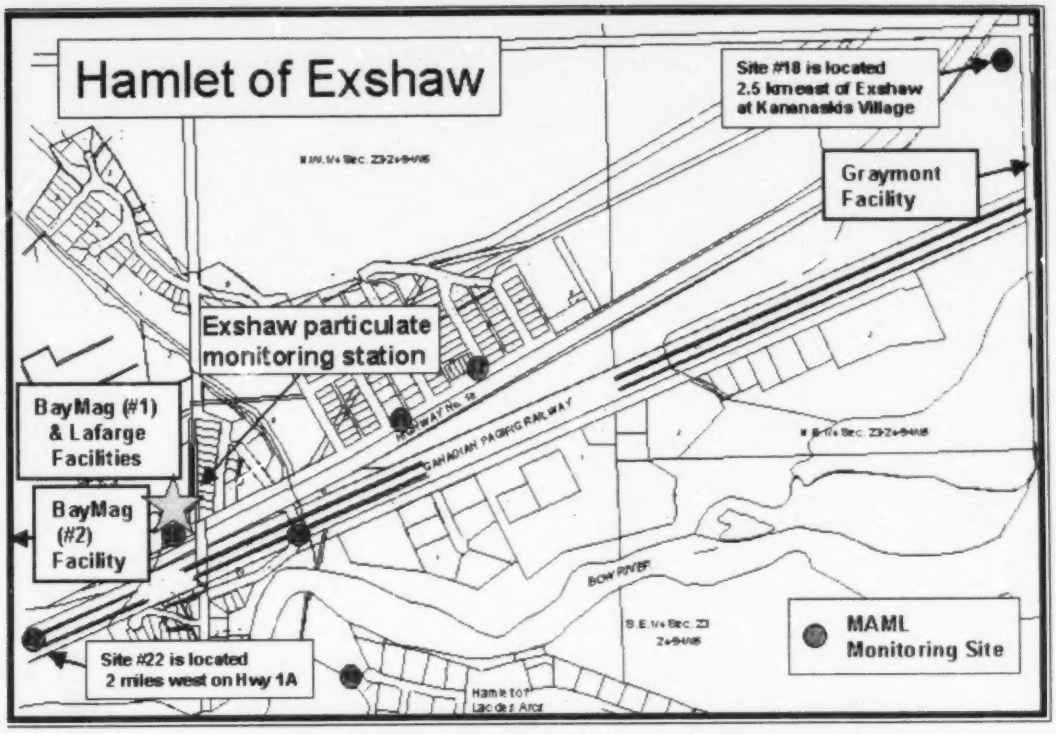
Hamlet of Exshaw
Site #18 is located 2.5 km east of Exshaw at Kananaskis Village
Graymont Facility
Exshaw particulate monitoring station
BayMag (#1) & Lafarge Facilities
BayMag (#2) Facility
Site #22 is located 2 miles west on Hwy 1A
MAML Monitoring Site

Figure 1.2 Locations monitored with the MAML in the Exshaw area.

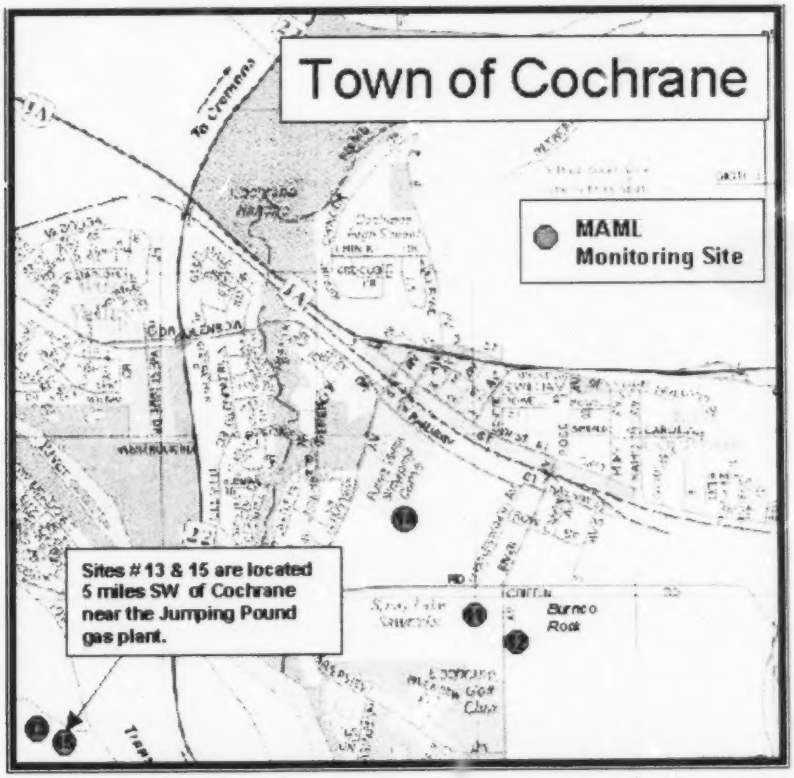

Figure 1.3 Locations monitored with the MAML in the Cochrane area.

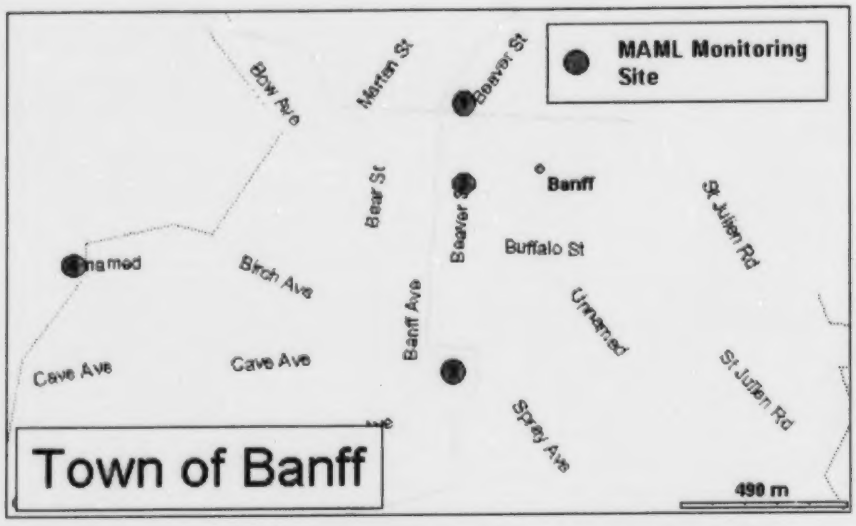

Figure 1.4 Locations monitored with the MAML in the Banff area.

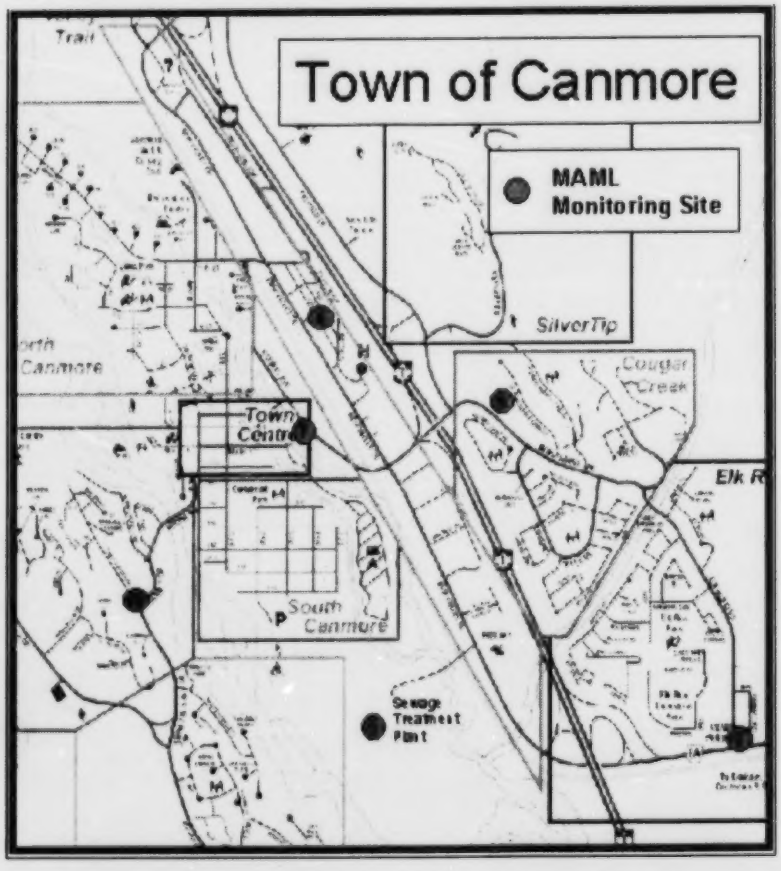

Figure 1.5 Locations monitored with the MAML in the Canmore area.

Table 1.1 List of site numbers and associated locations monitored by the MAML.

Area	Site #	Monitoring Location
Banff (four sites)	Site # 1	High School (Elk St. and Beaver St.)
	Site # 2	Canada Place (Banff Ave. and Spray Ave.)
	Site # 3	Fire Hall (Caribou St. and Beaver St.)
	Site # 4	Recreation grounds (end of Birch Ave.)
Canmore (six sites)	Site # 5	Wastewater Sewage Treatment Plant and Composting Operation
	Site # 6	2nd Ave. and 15th St.
	Site # 7	Main St. and Railway Ave. (Provincial Building parking lot)
	Site # 8	Elk Run Blvd. and Hwy 1A
	Site # 9	Parking area off Benchlands Tr.
	Site #10	Rundle Dr. and Three Sisters Dr. (old town hall)
Cochrane (five sites)	Site #11	Spray Lake Sawmill (east side on River Ave.)
	Site #12	Burnco Rock Products (west side on River Ave.)
	Site #13	Shell Jumping Pound Gas Plant (Rge. Rd. 51 and Twp. Rd. 252)
	Site #14	Domtar Excavation (1 block south of Railway St. on 2nd Ave.)
	Site #15	Shell Jumping Pound Gas Plant (Rge. Rd. 50 and Twp. Rd. 252)
Exshaw (seven sites)	Site #16	Municipal District of Bighorn #8 building
	Site #17	Mt. McGillivery Dr. and Heart Mountain Dr. on north side of Hwy 1A
	Site #18	2.5 km east of Exshaw at Kananaskis Village
	Site #19	Lac Des Arc
	Site #20	T-Intersection south side of Hwy 1A across railway tracks
	Site #21	Community Hall at Heart Mountain Dr. and Barrier Mountain Dr.
	Site #22	Grotto Mountain Picnic area

Table 1.2 Parameters monitored by the MAML in the Bow Corridor survey (also includes minimum detection limits and operating ranges).

Parameter Measured	Minimum Detectable Limit*	Operating Range**
sulphur dioxide (SO_2)	0.6 ppb	1 ppm
hydrogen sulphide (H_2S)	0.6 ppb	1 ppm
total reduced sulphur (TRS)	0.6 ppb	1 ppm
total hydrocarbons (THC)	0.005 ppm	20 ppm
reactive hydrocarbons (RHC)	0.005 ppm	20 ppm
methane (CH_4)	0.005 ppm	10 ppm
polycyclic aromatic hydrocarbons (PAHs)	3 ng/m^3	1000 ng/m^3
ozone (O_3)	0.001 ppm	0.5 ppm
nitrogen dioxide (NO_2)	1.0 ppb	1 ppm
nitric oxide (NO)	1.0 ppb	1 ppm
total oxides of nitrogen (NO_x)	1.0 ppb	1 ppm
total suspended particulates (TSP)	1 $\mu g/m^3$	1.0 g/m^3
inhalable particulates (PM_{10})	1 $\mu g/m^3$	1.0 g/m^3
respirable particulates ($PM_{2.5}$)	1 $\mu g/m^3$	1.0 g/m^3
carbon monoxide (CO)	0.1 ppm	50 ppm
ammonia (NH_3)	1.0 ppb	5 ppm
wind direction (WDR)	0 degrees	360 degrees
wind speed (WSP)	0 kph	200 kph
temperature (Temp)	-40 °C	50 °C
relative humidity (RH)	0 %	100 %

ppb = parts per billion
ppm = parts per million
ng/m^3 = nanograms per cubic metre
$\mu g/m^3$ = micrograms per cubic metre
g/m^3 = grams per cubic metre
kph = kilometres per hour
°C = degrees Celsius
% = per cent

* The ***minimum detectable limit*** indicates the ***minimum*** amount of pollutant the instrument can measure.

** The ***operating range*** indicates the ***maximum*** amount of pollutant the instrument can detect. This limit is set to provide the optimum precision over that range. The upper limit can be raised, however, precision at the lower levels (where most levels are monitored) is then compromised.

Alberta's Ambient Air Quality Guidelines

Alberta's Ambient Air Quality Guidelines[1] are established under Section 14 of the Environmental Protection and Enhancement Act (EPEA). EPEA provides for the development of guidelines and ambient environmental quality objectives for all or part of Alberta.

The Ambient Air Quality Guidelines are used for:

- reporting on the state of the atmospheric environment in Alberta.
- reporting to Albertans on the quality of air through an air quality index.
- establishing approval conditions for regulated industrial facilities.
- evaluating proposals to construct facilities that will have air emissions.
- guiding special ambient air quality surveys.
- assessing compliance near major industrial air emission sources.

Alberta's Ambient Air Quality Guidelines for one-hour concentrations of parameters monitored by the MAML are indicated in Table 1.2.

Some of Alberta's Ambient Air Quality Guidelines are based on odour perception. This is the case for sulphur dioxide, hydrogen sulphide, ammonia and nitrogen dioxide. For these chemicals, people are likely to detect an odour at concentrations well below levels that may affect human health.

[1] *Alberta Ambient Air Quality Guidelines.* Alberta Environment. February 2000.

Table 1.2 Alberta's Ambient Air Quality Guidelines for parameters measured by the MAML.

Air Quality Parameter	One-hour Guideline (ppm*)	Basis for Guideline
hydrogen sulphide	0.01	odour perception
ammonia	2	odour perception
carbon monoxide	13	oxygen carrying capacity of blood
nitrogen dioxide	0.212	odour perception
ozone	0.082	reduction of lung function and effects on tomatoes
sulphur dioxide	0.172	taste, odour perception and effects on bluegrass

* Parts per million by volume.

Sulphur Dioxide (SO_2)

Maximum one-hour concentration recorded during survey	One-hour guideline
0.092 ppm	0.172 ppm (based on taste, odour perception and effects on bluegrass)

Sulphur dioxide (SO_2) is a colourless gas with a pungent odour. It is estimated that in Alberta 45% of SO_2 emissions are produced by natural gas processing plants while oil sands and power plants produce about 26% and 21% of SO_2 emissions, respectively[2]. Other sources include gas plant flares, oil refineries, pulp and paper mills and fertilizer plants. Cement manufacturing facilities will also emit SO_2.

SO_2 levels were below Alberta's one-hour guideline at all sites monitored during the Bow Corridor survey (see Figure 1.6). The highest SO_2 concentrations were measured in the Exshaw area. The maximum one-hour concentration was 0.092 ppm recorded at Site #20 (south of Hwy #1A across the railway tracks in Exshaw). This value is 53 per cent of the one-hour guideline for SO_2. The median concentration based on all samples collected in Exshaw was 0.008 ppm compared to median values less than 0.002 ppm in the Banff, Canmore and Cochrane areas.

The overall median SO_2 concentration in the Bow Corridor survey was 0.001 ppm. This is in the range of SO_2 levels observed at other locations in Alberta. Based on data from 20 permanent monitoring stations in Alberta, median SO_2 concentrations ranged from 0.000 ppm (below the instrument detection limit) to 0.002 ppm in 2000. Data for other locations in Alberta are presented in Tables A.3 and A.4 of Appendix A.

The maximum one-hour SO_2 concentration measured in the Bow Corridor survey (0.092 ppm) was within the range of typical maximum one-hour values that are measured at other locations in Alberta. Based on 2000 data from 20 permanent stations (see Tables A.3 and A.4 in Appendix A), maximum one-hour SO_2 concentrations ranged from 0.009 ppm at the background station of Hightower Ridge (65 km northwest of Hinton) to 0.284 ppm at the Mannix station (30 km north of Fort McMurray).

The **median concentration** is a common way of representing the central value for environmental data. Most environmental data usually consist of a distribution that is skewed to the right; that is most data values are low and only a few are high. The arithmetic mean will be biased by the high concentrations and will reveal a value that may not be representative of the central value for the data. The median is the middlemost value in the data, dividing the distribution into two equal halves. Therefore, the median is more representative of the central value of the data distribution.

For example, consider a data distribution consisting of five numbers: 1,2,2,2,3 and 10. The arithmetic mean of these data is 3.6 and median is 2. In this case, the arithmetic mean is biased high by the extreme value of 10. The median value is actually a true central value of the data distribution.

[2] Environment Canada. 1998. *1995 Criteria Air Contaminant Emissions Inventory Summaries.* Pollution Data Branch, Environment Canada. http://www2.ec.gc.ca/pdb/cac/cac.html.

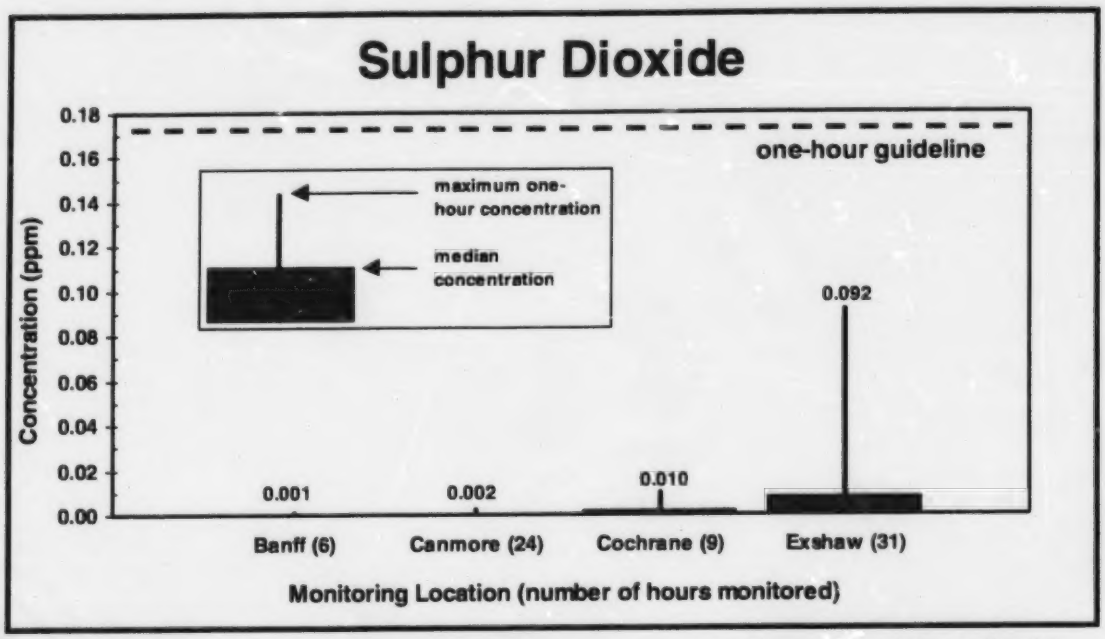

Figure 1.6 One-hour median and maximum concentrations of sulphur dioxide.

Particulates (TSP, PM_{10} and $PM_{2.5}$)

Maximum one-hour concentration recorded during survey	One-hour guideline
TSP = 2082 $\mu g/m^3$	no guideline
PM_{10} = 1094 $\mu g/m^3$	no guideline
$PM_{2.5}$ = 60 $\mu g/m^3$	no guideline

Air pollutants are not necessarily in a gaseous form. Tiny particles of solid material or liquid droplets, defined collectively as particulates, are also present in the atmosphere. Total suspended particulates (TSP) refer to all particles up to 500 micrometres in diameter (a human hair is about 100 micrometres in diameter). Particles greater than 10 micrometres in diameter are important primarily from a nuisance perspective. Particles less than 10 micrometres in diameter (PM_{10}) can be inhaled into the nose and throat while smaller particles, less than 2.5 micrometres in diameter ($PM_{2.5}$), can penetrate into the lungs.

Sources of particulates include soil dust, road dust, agricultural dust (e.g., harvest), smoke from forest fires and recreational wood burning, vehicle exhaust emissions, brake and tire wear, and industrial emissions. Smaller particles ($PM_{2.5}$) originate in the atmosphere because of condensation and combustion from sources such as vehicle exhaust emissions, industrial emissions and wood burning. $PM_{2.5}$ are also formed as a result of reactions of gaseous chemicals in the air.

In the Bow Corridor, there are several sources of airborne particulates. These include: wind-blown dust from natural sources (such as Lac des Arc); limestone mining operations; manufacturing plants (cement, lime and magnesia); vehicle exhaust from local traffic and Highway #1;

and smoke from recreational wood burning and forest fires.

Alberta, as well as other jurisdictions in Canada, does not have one-hour guidelines for TSP, PM_{10} or $PM_{2.5}$. However, Alberta does have a 24-hour guideline for TSP of 100 $\mu g/m^3$. In addition, there is a 24-hour Canada-wide Standard (CWS) benchmark concentration for $PM_{2.5}$ of 30 $\mu g/m^3$. Alberta Environment has estimated that this is equivalent to a one-hour concentration of 80 $\mu g/m^3$. This one-hour equivalent concentration is used as a reference for comparison to one-hour $PM_{2.5}$ levels. The estimation of this one-hour equivalent concentration is discussed further in Part 2 of this report.

$PM_{2.5}$ levels measured during the Bow Corridor survey were lower than the one-hour equivalent CWS benchmark concentration of 80 $\mu g/m^3$. The maximum one-hour maximum $PM_{2.5}$ concentration (60 $\mu g/m^3$) was measured at Site #15 (Shell Jumping Pound Gas Plant). The highest levels of TSP (2082 $\mu g/m^3$) and PM_{10} (1094 $\mu g/m^3$) were also measured at this location. These elevated particulate values were caused by road dust from traffic along gravel roads adjacent to the monitoring site.

Elevated levels of large particulates (TSP) and PM_{10} were measured in Cochrane at Site #11 (Spray Lake Sawmill) and Site #12 (Burnco Rock Products). Maximum TSP and PM_{10} levels at Site #11 were 310 and 176 $\mu g/m^3$, respectively. At Site #12, the maximum TSP and PM_{10} concentrations were 643 and 383 $\mu g/m^3$, respectively. Maximum $PM_{2.5}$ concentrations at these two sites were much lower with values of 15 and 34 $\mu g/m^3$, respectively. Particulates measured at Sites #11 and #12 were likely due to activities on the adjacent industrial sites.

Elevated levels of large particulates were measured in the Exshaw area at Site #16 (Municipal District of Bighorn #8 building) and Site #17 (Mt. McGillivery Dr. and Heart Mountain Dr.). Maximum one-hour TSP concentrations at these two locations were 385 and 427 $\mu g/m^3$, respectively. Maximum PM_{10} levels were 210 and 201 $\mu g/m^3$ at these sites, respectively. The maximum one-hour $PM_{2.5}$ concentration measured in Exshaw by the MAML was 19 $\mu g/m^3$, well below the one-hour equivalent CWS benchmark concentration of 80 $\mu g/m^3$.

Particulate levels in the Canmore and Banff area were low during the survey. The highest one-hour TSP, PM_{10} and $PM_{2.5}$ levels measured in these communities were 95 $\mu g/m^3$, 58 $\mu g/m^3$ and 9 $\mu g/m^3$, respectively.

Concentrations of large particulates (TSP) and PM_{10} were higher in the Bow Corridor than at other locations monitored in Alberta. The median TSP and PM_{10} concentrations measured by the MAML for the entire Bow Corridor survey were 74 and 40 $\mu g/m^3$, respectively. These values are higher than those recorded in other MAML surveys conducted in the Caroline/Sundre, Lethbridge, Medicine Hat and Grande Prairie areas. Median TSP concentrations from these surveys ranged from 4 $\mu g/m^3$ in the Caroline/Sundre area to 42 $\mu g/m^3$ in the Lethbridge area. Median PM_{10} concentrations ranged from 3 $\mu g/m^3$ in the Caroline/Sundre area to 24 in the Lethbridge area.

The median $PM_{2.5}$ concentration in the Bow Corridor survey was 4 $\mu g/m^3$. This value is similar to $PM_{2.5}$ levels measured at permanent rural and small urban monitoring stations that ranged from 3 to 5 $\mu g/m^3$ in 2000. The median $PM_{2.5}$ concentration measured in the Bow Corridor was lower than median values measured in 2000 at Edmonton and Calgary stations (8 to 9 $\mu g/m^3$). See Tables A.3 and A.4 in Appendix A for Alberta data.

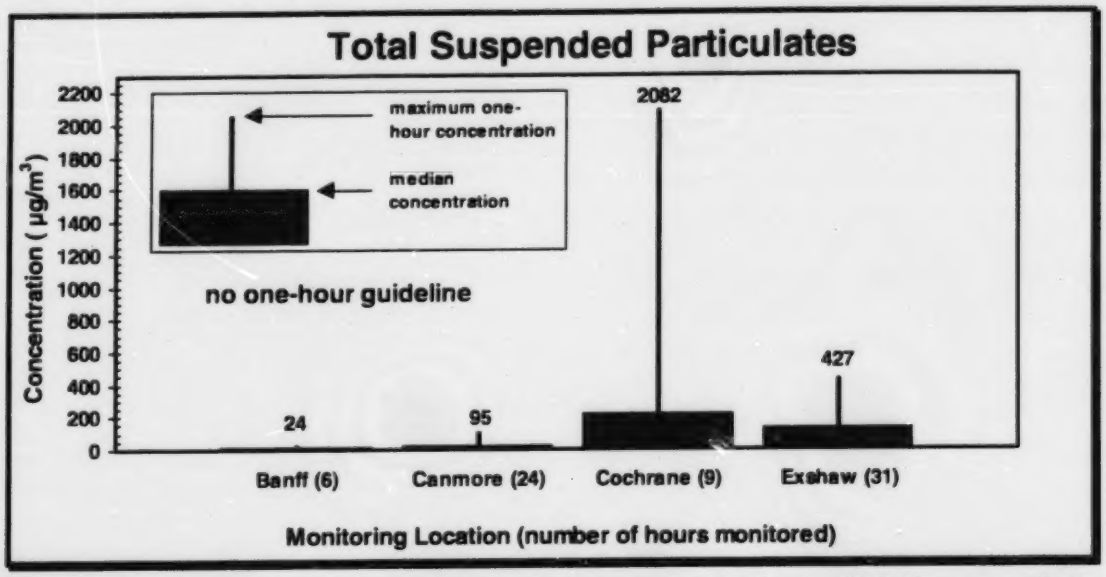

Figure 1.7 One-hour median and maximum concentrations of total suspended particulates.

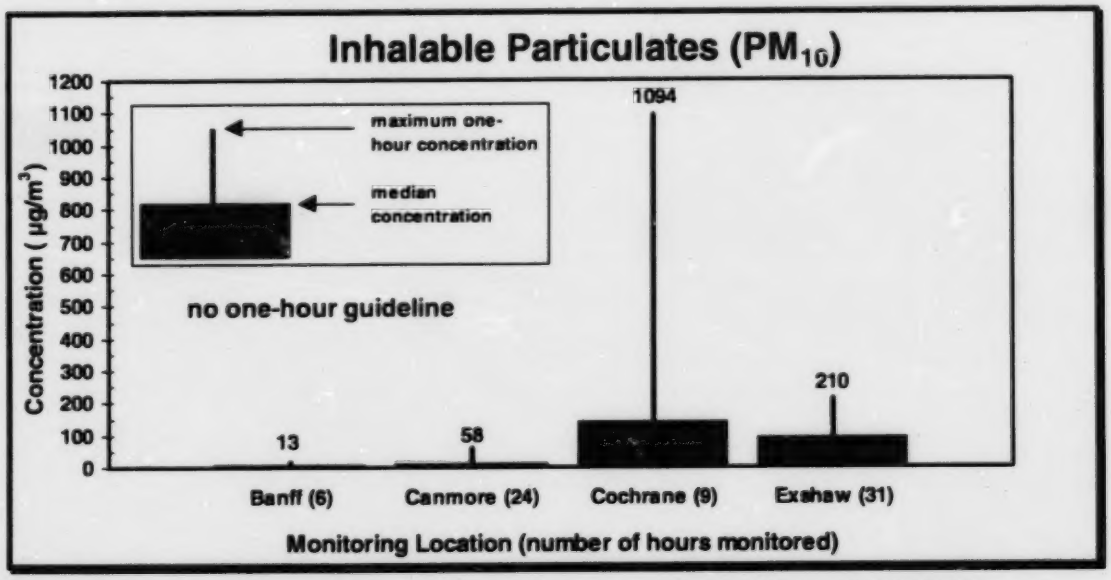

Figure 1.8 One-hour median and maximum concentrations of inhalable particulates (PM_{10}).

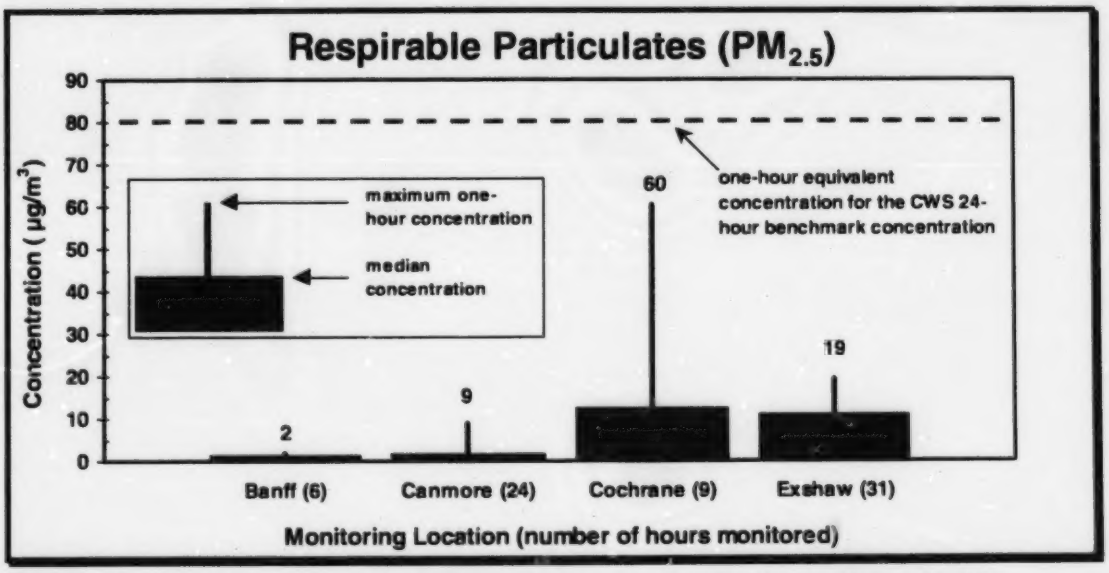

Figure 1.9 One-hour median and maximum concentrations of respirable particulates ($PM_{2.5}$).

Oxides of Nitrogen (NO_2, NO and NO_x)

Maximum one-hour concentration recorded during survey	One-hour guideline
NO_2 = 0.031 ppm	0.212 ppm (based on odour perception)
NO = 0.296 ppm	no guideline
NO_x = 0.296 ppm	no guideline

Oxides of nitrogen (NO_x) are the total of nitrogen dioxide (NO_2) and nitric oxide (NO). During high temperature combustion - as in the burning of natural gas, coal, oil and gasoline - atmospheric nitrogen may combine with molecular oxygen to form NO. NO is colourless and odourless. Most NO in the ambient air is oxidized to form NO_2. NO_2 is a reddish-brown gas with a pungent odour. The major source of oxides of nitrogen in urban areas is vehicle exhaust emissions. Processes associated with the oil and gas industry also emit oxides of nitrogen into the atmosphere. In the Bow Corridor, the major sources of oxides of nitrogen are vehicle exhaust emissions and industrial emissions.

As shown in Figure 1.16, NO_2 levels were below Alberta's one-hour guideline at all monitoring locations in the Bow Corridor survey. The maximum NO_2 concentration was recorded at Site #20 (T-Intersection on south side of Hwy #1A across railway tracks in Exshaw) from 9:51 a.m. to 10:50 a.m. on September 26, 2001. The maximum NO_2 value measured at this time (0.031 ppm) is 15 per cent of the one-hour guideline. The highest levels of NO and NO_x were also recorded at this location.

Median NO_2 concentrations were higher in the Cochrane and Exshaw areas than the Canmore and Banff areas. Median NO_2 values in the Cochrane and Exshaw areas were 0.015 and 0.010 ppm, respectively, compared to median concentrations of 0.004

and 0.005 ppm in the Canmore and Banff areas, respectively.
The overall median NO_2 concentration based on all data collected in the Bow Corridor was 0.007 ppm. This is similar to typical median values observed in smaller urban centres in Alberta. Median NO_2 concentrations at the Red Deer, Fort McMurray (Athabasca Valley) and Fort Saskatchewan stations in 2000 ranged from 0.007 to 0.010 ppm. NO_2 levels in Edmonton and Calgary were much higher with median values in 2000 ranging from 0.014 to 0.027 ppm.

The primary source of oxides of nitrogen in the Bow Corridor are vehicle exhaust emissions and emissions from industrial facilities. However, as mentioned earlier, NO_2 concentrations in the Bow Corridor were low compared to the one-hour guideline.

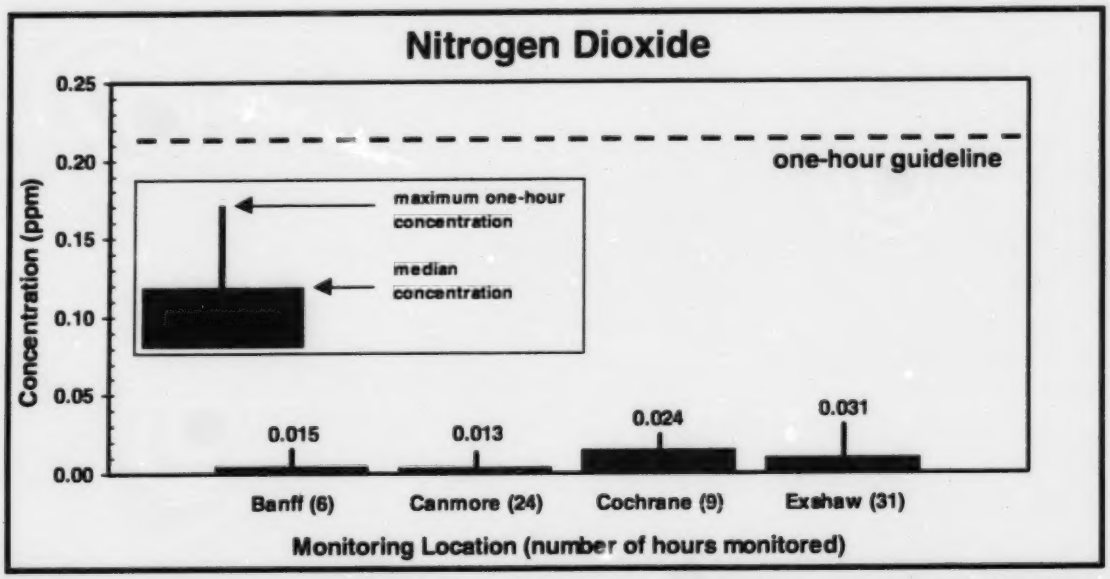

Figure 1.10 One-hour median and maximum concentrations of nitrogen dioxide.

Ozone (O_3)

Maximum one-hour concentration recorded during survey	One-hour guideline
0.056 ppm	0.082 ppm (based on reduction of lung function and effects on tomatoes)

Ozone in the lower atmosphere is produced by: (1) the reaction of oxides of nitrogen and volatile organic compounds in the presence of sunlight, and (2) transport of O_3 from the upper atmosphere to ground level. Transport from the upper atmosphere is likely the dominant ozone producing process in the fall, winter and early spring seasons. O_3 concentrations are generally lower in urban centres due to the destruction of O_3 by nitric oxide.

O_3 concentrations in the Bow Corridor followed typical daily and seasonal variations that are observed at other locations in Alberta. The highest O_3 concentrations were generally measured in the afternoon of the spring and summer seasons. The maximum one-hour average O_3 concentration was recorded from 4:23 p.m. to 5:23 p.m. on March 21, 2000 at Site #18 (2.5 km east of Exshaw at Kananaskis Village). The maximum value recorded at this site (0.056 ppm) is 68 per cent of the one-hour guideline for O_3. Maximum one-hour O_3 concentrations in the winter, spring, summer and fall survey periods were 0.024, 0.056, 0.053 and 0.032 ppm, respectively.

O_3 concentrations were fairly uniform in the Bow Corridor with median values ranging from 0.028 ppm in the Cochrane area to 0.032 ppm in Banff. Median O_3 levels in the Canmore and Exshaw areas were 0.029 and 0.031 ppm, respectively.

The median O_3 concentration for the entire Bow Corridor survey was 0.030 ppm. In 2000, median O_3 levels at rural and background locations in Alberta ranged from 0.019 ppm at the Fort McKay station to 0.045 ppm at the Hightower Ridge station (65 km northwest of Hinton). O_3 levels in large cities are generally much lower than in rural areas. Median O_3 levels at permanent monitoring stations in Edmonton and Calgary in 2000 ranged from 0.012 to 0.020 ppm. Lower O_3 levels in urban centres are due to the destruction of natural O_3 by nitric oxide emitted by vehicles.

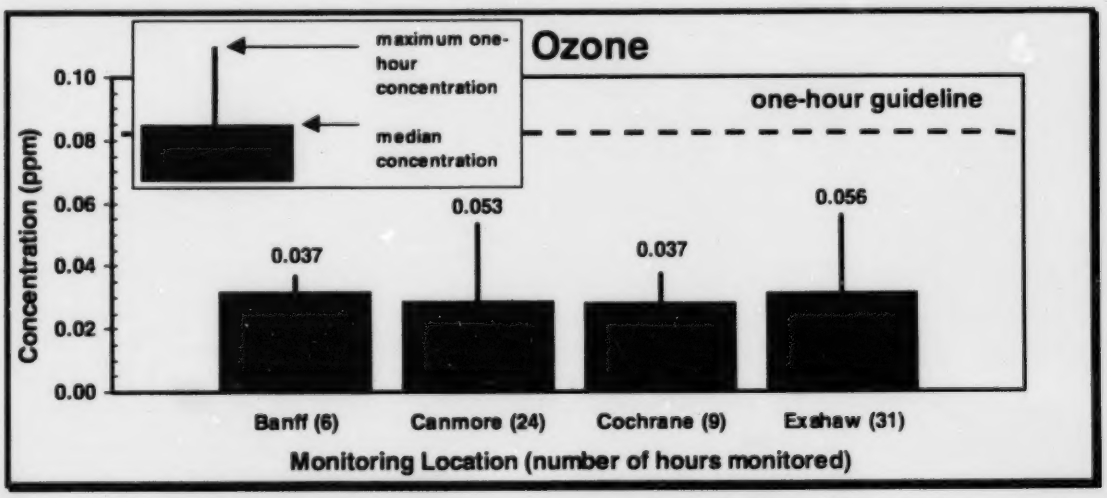

Figure 1.11 One-hour median and maximum concentrations for ozone.

Hydrocarbons (THC, RHC and CH_4)

Maximum one-hour concentration recorded during survey	One-hour guideline
THC = 7.8 ppm	no guideline
RHC = 6.6 ppm	no guideline
CH_4 = 2.2 ppm	no guideline

The term "total hydrocarbons" (THC) refers to a broad family of chemicals that contain carbon and hydrogen atoms. Methane (CH_4), a non-reactive hydrocarbon, is the most common hydrocarbon in the earth's atmosphere. Specific reactive hydrocarbons (RHC) are important because: (1) they can react with oxides of nitrogen in the presence of sunlight to form ozone; and (2) they can be toxic (at high concentrations) to humans, animals or vegetation. Sources of hydrocarbons include vegetation, vehicle emissions, gasoline marketing and storage tanks, petroleum and chemical industries, dry cleaning, fireplaces, natural gas combustion and aircraft traffic. Hydrocarbons are also emitted by fugitive sources such as evaporation of solvents, or leaking valves, flanges, pumps and compressors at industrial facilities. Incinerator and flare stacks can also be sources of hydrocarbons.

Many hydrocarbons, such as CH_4, are emitted by natural sources. Normal background THC concentrations recorded in rural Alberta range from 1.5 to 2 ppm. Background hydrocarbons are primarily composed of CH_4 with a small contribution from RHC (about 0.2 ppm).

Hydrocarbon concentrations were close to normal background levels at most locations in the Bow Corridor survey. The only exception was at Site #3 (Fire Hall at Caribou St. and Beaver St. in Banff) where an elevated hydrocarbon concentration was measured from 5:18 p.m. to 6:36 p.m. on August 6, 2000. The elevated hydrocarbon levels measured at this site were attributed to a bulk fuel truck unloading at a gas station across the alley (about 25 metres) from the monitoring unit.

The overall median THC concentration in the Bow Corridor was 1.9 ppm. This value is typical for rural locations in Alberta. Median THC levels at permanent monitoring stations in Alberta ranged from 1.8 to 2.3 ppm in 2000 (see Tables A.3 and A.4 in Appendix A).

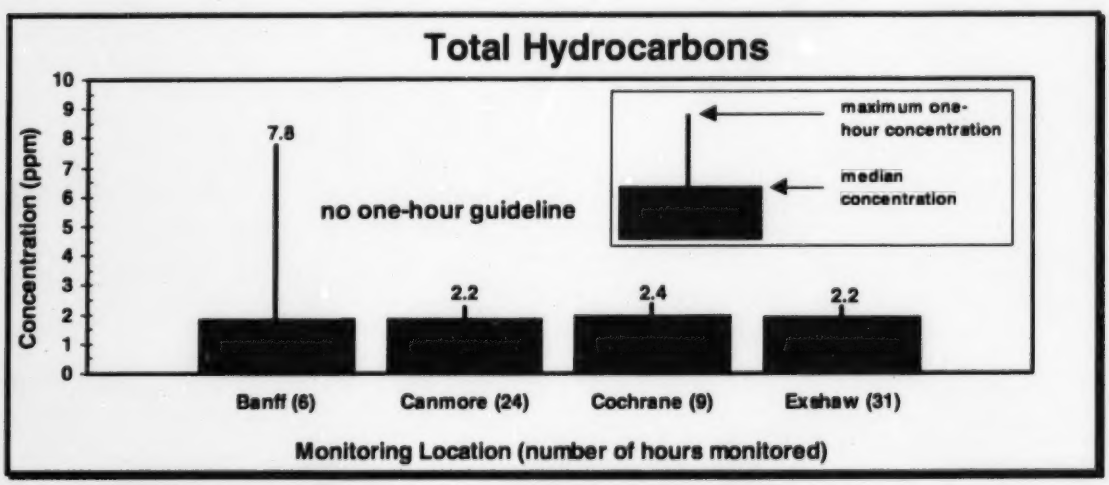

Figure 1.12 One-hour median and maximum concentrations of total hydrocarbons.

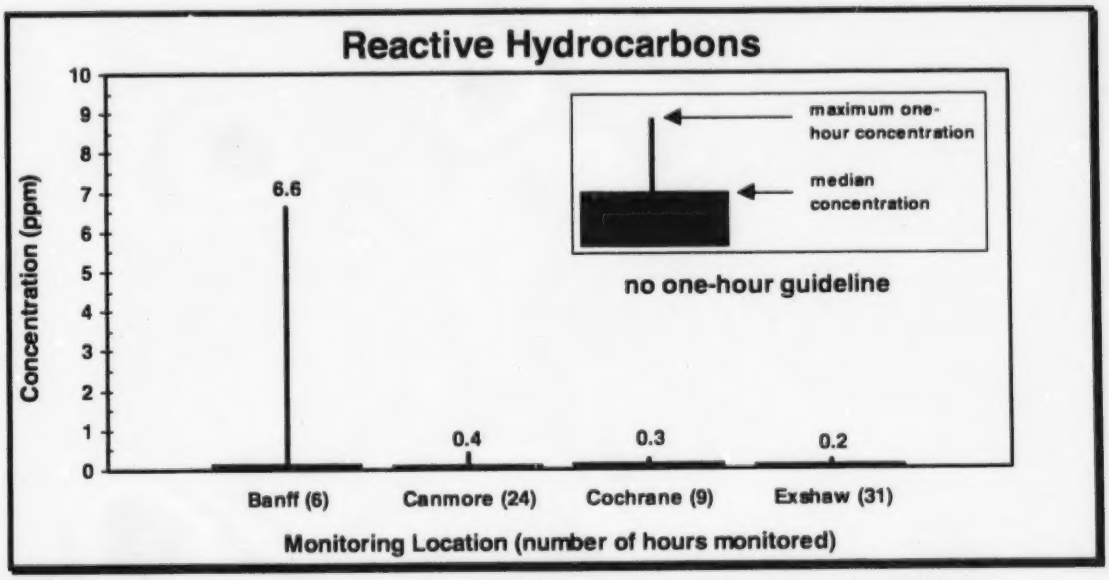

Figure 1.13 One-hour median and maximum concentrations of reactive hydrocarbons.

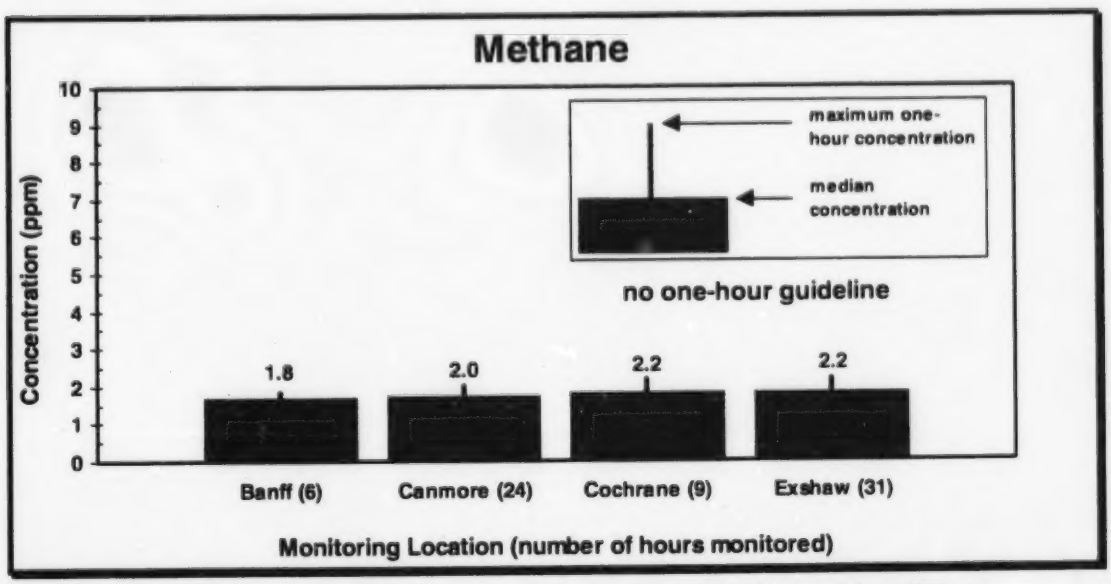

Figure 1.14 One-hour median and maximum concentrations of methane.

Carbon Monoxide (CO)

Maximum one-hour concentration recorded during survey	One-hour guideline
1.1 ppm	13.0 ppm (based on the oxygen-carrying capacity of blood)

Carbon monoxide (CO) is a colourless, odourless gas emitted into the atmosphere primarily by motor vehicles. Minor sources include fireplaces, industry, aircraft and natural gas combustion. The major source of carbon monoxide at urban locations is vehicle exhaust emissions.

CO values were low during the entire survey in the Bow Corridor. The maximum one-hour concentration of 1.1 ppm was recorded at Site #18 (2.5 km east of Exshaw at Kananaskis Village) from 8:38 a.m. to 9:37 a.m. on September 26, 2000. This maximum one-hour concentration is 8 per cent of the one-hour guideline for CO. Maximum one-hour CO concentrations were 0.7 ppm or lower at the other monitoring sites during this survey.

The overall median CO concentration was slightly higher in Banff (0.4 ppm) than in the Canmore (0.1 ppm), Cochrane (0.1 ppm) and Exshaw (0.2 ppm) areas. Slightly higher levels in Banff are likely due to vehicle exhaust from local traffic.

The overall median concentration in the Bow Corridor survey was 0.2 ppm. Median CO concentrations at permanent locations in Alberta ranged from 0.2 to 0.6 ppm in 2000. The highest CO levels are usually measured in Edmonton and Calgary and are caused by vehicle exhaust emissions.

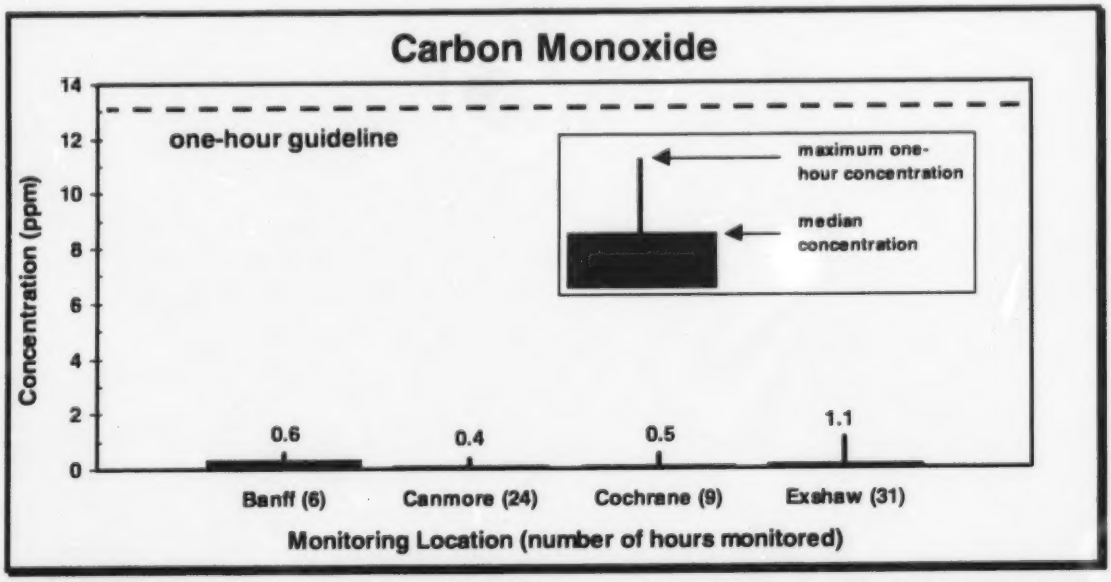

Figure 1.15 One-hour median and maximum concentrations of carbon monoxide.

Hydrogen Sulphide and Total Reduced Sulphur (H_2S and TRS)

Maximum one-hour concentration recorded during survey	One-hour guideline
H_2S = 0.002 ppm	0.010 ppm (based on odour perception)
TRS = 0.004 ppm	no guideline

Hydrogen sulphide (H_2S) is a colourless gas with a rotten egg odour. Total reduced sulphur (TRS) includes hydrogen sulphide, mercaptans, dimethyl sulphide, dimethyl disulphide and other sulphur compounds. Sulphur dioxide is not included in the determination of TRS. Industrial sources of H_2S and TRS include fugitive emissions (leakages) from petroleum refineries, tank farms for unrefined petroleum products, natural gas plants, petrochemical plants, oil sands plants, sewage treatment facilities, pulp and paper plants that use the Kraft pulping process, and animal feedlots. Natural sources of H_2S include sulphur hot springs, sloughs, swamps and lakes.

H_2S concentrations were well below Alberta's one-hour air quality guideline at all locations monitored during the survey. The maximum one-hour H_2S concentration of 0.002 ppm was measured at four sites (Site #3, Site#17, Site #18 and Site #20). This maximum value is 20 per cent of the one-hour guideline for H_2S. The maximum one-hour TRS concentration of 0.004 ppm was measured at Site #20.

H_2S concentrations will sometimes exceed the one-hour, odour based, guideline at monitoring locations situated close to H_2S sources. For example, the maximum one-hour H_2S concentration measured at the Edmonton East and Calgary East monitoring stations in 2000 were 0.029 and 0.022 ppm, respectively. These maximum values are more than ten times higher than the maximum concentration measured in the Bow Corridor survey (0.002 ppm).

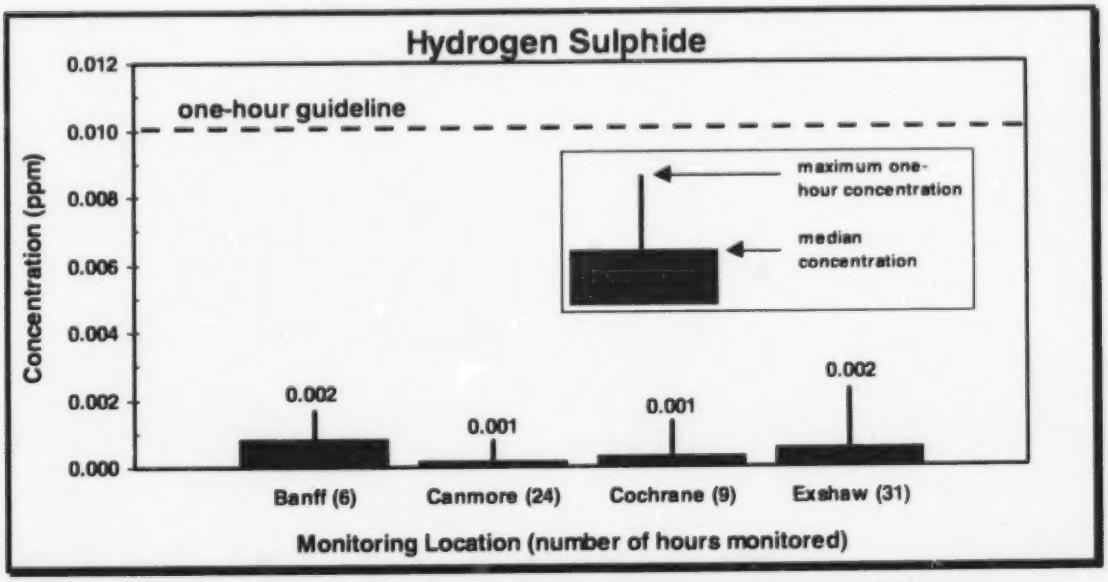

Figure 1.16 One-hour median and maximum concentrations of hydrogen sulphide.

Polycyclic Aromatic Hydrocarbons (PAHs)

Maximum one-hour concentration recorded during survey	One-hour guideline
36 ng/m^3	no guideline

Polycyclic aromatic hydrocarbons (PAHs) are a class of chemicals that are usually contained in soot and smoke. There are more than 100 different PAHs with varying levels of toxicity. They are formed during the incomplete combustion of gasoline, diesel, oil, coal, wood, garbage or other organic substances. Tobacco smoke and charbroiled meats are common sources of PAHs. Other outdoor PAH sources include vehicle exhaust emissions, wood smoke from fireplaces, smoke from forest fires and industrial facilities. PAHs occur in the atmosphere in the vapour phase or attached to dust particles. The PAH monitoring instrument aboard the MAML will analyze only particulate bound PAHs.

The highest one-hour average PAH concentration was recorded at Site #11 (near Spray Lake Sawmill, east side on River Ave. in Cochrane) from 7:53 a.m. to 8:55 a.m. on July 12, 2000. The second highest one-hour PAH concentration was also measured at Site #11 from 9:48 to 10:47 a.m. on December 16, 1999. PAH levels at these two times were 36 and 35 ng/m^3 (nanograms per cubic metre), respectively. The MAML operator noted sawmill type odours while monitoring at Site #11. PAHs measured at this site were likely from the adjacent sawmill facility.

The median PAH concentration in the Bow Corridor survey ranged from 3 ng/m^3 in Canmore to 16 ng/m^3 in Cochrane. Median concentrations in Banff and Exshaw were 8 and 5 ng/m^3, respectively. The overall median PAH concentration in the Bow Corridor survey was 4 ng/m^3. Median PAH levels during other surveys conducted by the MAML in Alberta ranged from 2 to 5 ng/m^3. Maximum one-hour PAH levels from these surveys ranged from 11 to 35 ng/m^3.

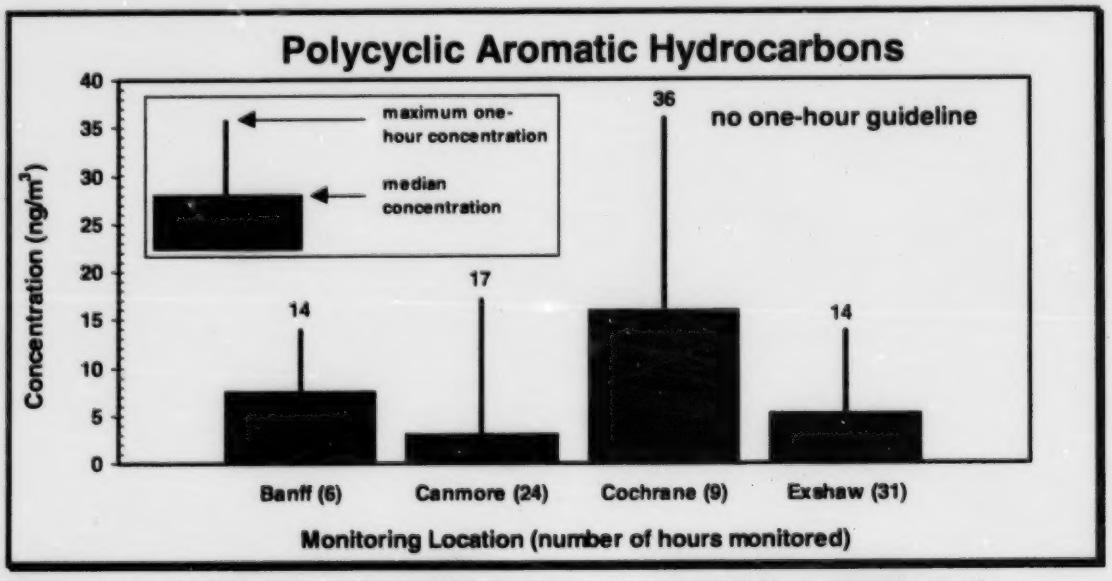

Figure 1.17 One-hour median and maximum concentrations of polycyclic aromatic hydrocarbons.

Ammonia (NH_3)

Maximum one-hour concentration recorded during survey	One-hour guideline
0.034 ppm	2.0 ppm (based on odour perception)

Ammonia is a colourless gas with the well-known pungent odour found in household cleaners. NH_3 is produced both by natural and man-made sources. Some natural sources of NH_3 include the decay of plant material and animal waste. A small portion is also released during respiration. In Alberta, the fertilizer industry is the main industrial source of NH_3. The industry produces synthetic NH_3 for either direct application to soil as a fertilizer, or as a raw material for use in the production of other high nitrogen fertilizer products. The other major source of NH_3 is commercial feedlots, specifically from their large amounts of animal waste.

NH_3 levels in the Bow Corridor were very low at all monitoring sites. The highest one-hour average NH_3 concentration was measured at Site #6 (2nd Ave. and 15th St. in Canmore) from 4:16 p.m. to 5:16 p.m. on July 12, 2000. The maximum concentration measured at this time (0.034 ppm) is less than 2 per cent of the one-hour guideline for NH_3. NH_3 was also detected at low levels at Sites #11, #16, and #20 with maximum one-hour values ranging from 0.024 to 0.030 ppm.

The median NH_3 levels ranged from 0.001 ppm in Canmore and Exshaw to 0.005 ppm in Exshaw. The overall median NH_3 concentration for the Bow Corridor survey was 0.001 ppm. Median NH_3 concentrations at other mobile air quality surveys conducted in Alberta ranged from 0.001 ppm in the County of Grande Prairie to 0.075 ppm in the Lethbridge area. The median NH_3 concentration at the Fort Saskatchewan permanent monitoring station was 0.003 ppm, based on 2000 data.

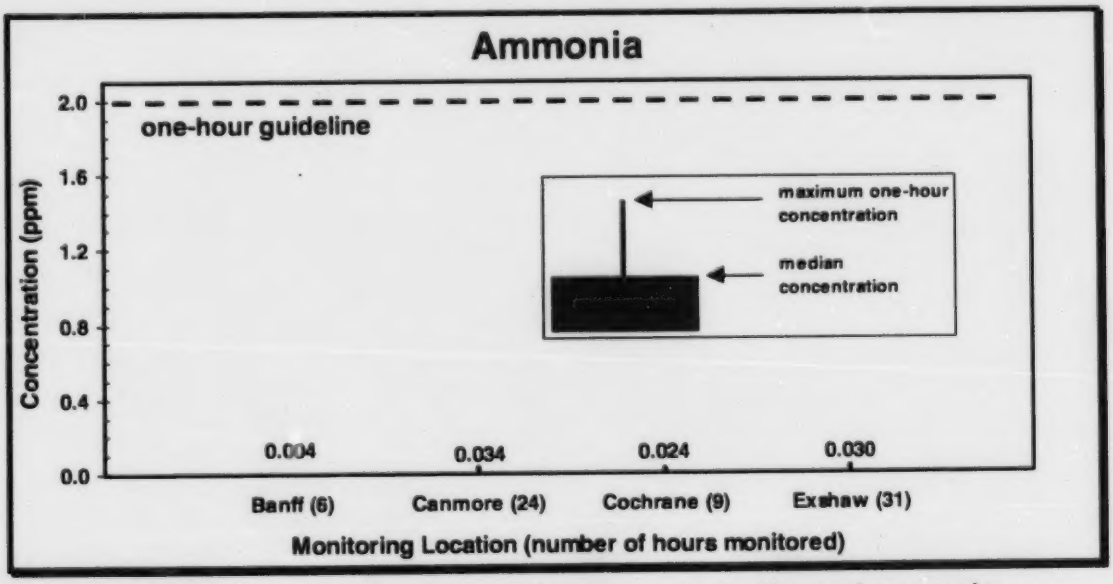

Figure 1.18 One-hour median and maximum concentrations of ammonia.

Part 2: Particulate Monitoring in Exshaw

An air quality station was set up in Exshaw from July 2000 to August 2001 to measure continuous, or hourly, particulate and weather parameters. Small, respirable particulates ($PM_{2.5}$) were measured from July 12, 2000 to July 3, 2001 and larger, inhalable particulates (PM_{10}) were measured from July 3, 2001 to August 31, 2001. Wind direction and speed, relative humidity and temperature were also monitored in Exshaw.

The Exshaw station was located on the roof of the Municipal District of Bighorn No. 8 building on Heart Mountain Drive (Figures 2.1 and 2.2). This building is situated just to the southeast of the Lafarge Cement Plant and Baymag #1 facility in Exshaw. The location of the Exshaw air quality station is indicated in Figure 1.2 on page 3 of this report.

Particulate Monitoring Method

Particulates were monitored on a continuous basis using the Tapered Element Oscillating Microbalance (TEOM). The TEOM draws an air sample through an inlet stream that aerodynamically separates particles of a specified diameter (e.g. 2.5 or 10 micrometres). The air sample then passes through a filter that is attached to a tapered element in the mass transducer. This tapered element vibrates at its natural frequency. As particles are deposited onto the filter the oscillating frequency changes in proportion to the amount of mass deposited.

Particulate Sources

Larger particles (up to 500 microns in diameter) referred to as total suspended particulates (TSP), are important primarily from a nuisance perspective. As a point of reference, a human hair is about 100 micrometres in diameter. Particles less than 10 micrometres in diameter (PM_{10}) can be inhaled into the nose and throat. $PM_{2.5}$ are particles less than 2.5 micrometres in diameter and are important because they can penetrate into the lungs and, depending on their composition, be a human health concern.

Particulates in the atmosphere have numerous sources including vehicle exhaust, soil dust, road dust, agricultural dust (e.g. harvest), smoke from forest fires and recreational wood burning, brake and tire wear, and industrial emissions. Smaller particles ($PM_{2.5}$) originate in the atmosphere because of condensation and combustion from sources such as vehicle exhaust emissions, industrial emissions and wood burning. The major sources of particulates in the Bow Corridor include wind-blown dust from natural sources (e.g. Lac des Arc), emissions from industrial facilities in the Exshaw area, limestone mining operations, vehicle exhaust from local traffic and Highway #1, and smoke from recreational wood burning and forest fires.

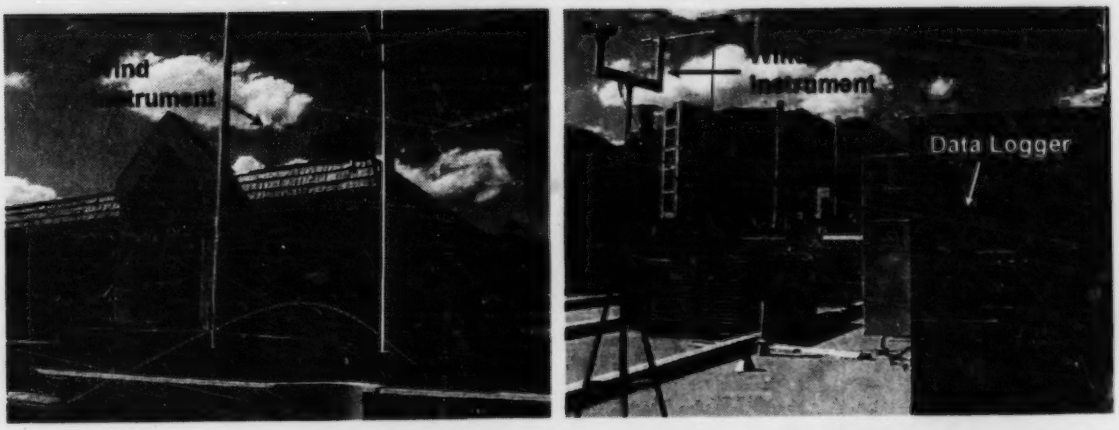

Figure 2.1 Particulate and wind instrumentation on top of Municipal District of Bighorn #8 building in Exshaw.

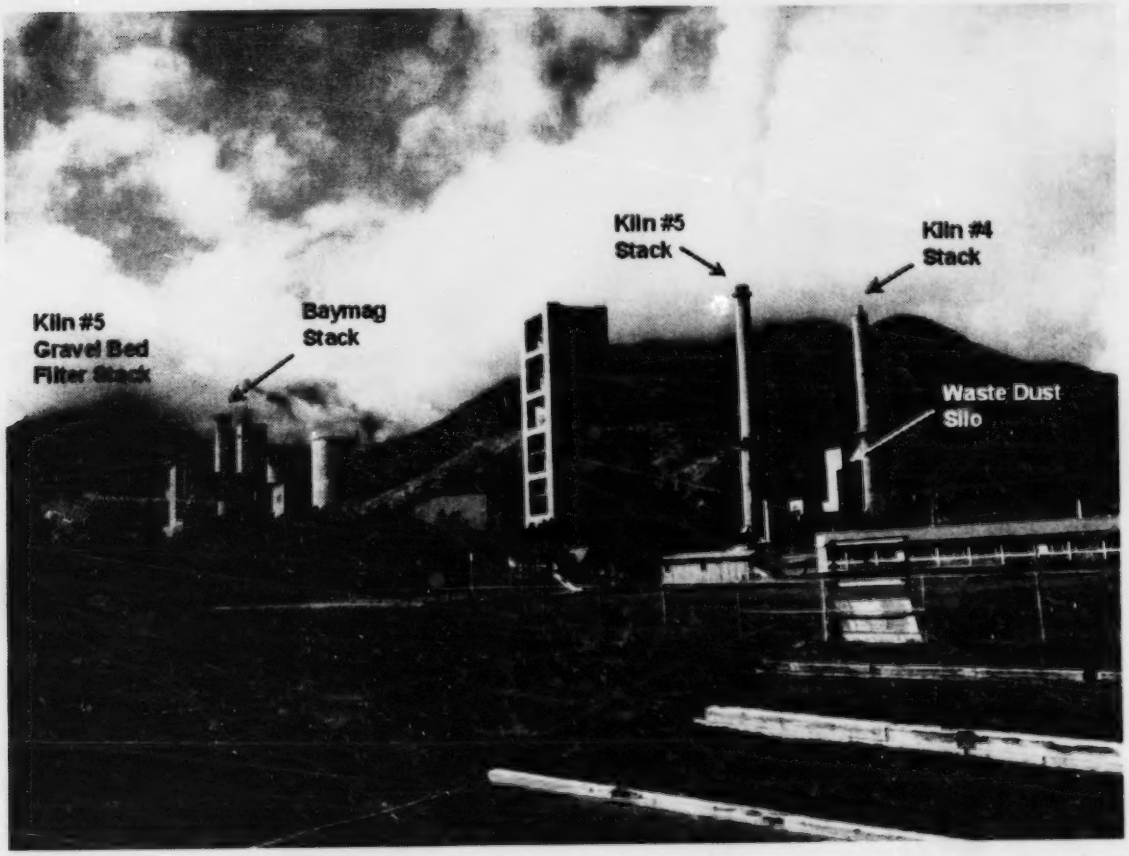

Figure 2.2 Looking northwest towards Baymag#1 and Lafarge facilities from Exshaw air quality station.

Particulate Guidelines and Standards

The Canada-wide Standard (CWS) benchmark for 24-hour $PM_{2.5}$ concentrations is 30 $\mu g/m^3$ (micrograms of particulate per cubic metre of air). The actual achievement statistic for the $PM_{2.5}$ CWS is based on a complex calculation process that involves using the 98th percentile annual value, averaged over three consecutive years.[3]

Alberta Environment has estimated a one-hour equivalent concentration for the 24-hour CWS benchmark of 80 $\mu g/m^3$. This one-hour equivalent concentration is based on an empirical relationship generated from $PM_{2.5}$ data collected in Edmonton and Calgary. Since this empirical relationship was developed based on urban data where vehicles are the major $PM_{2.5}$ source, caution should be exercised when comparing data collected in the Bow Corridor to this one-hour equivalent concentration. This is because the $PM_{2.5}$ sources in the Bow Corridor (industry, vehicles and natural) are somewhat different than those in Edmonton and Calgary. Therefore, the relationship between 24-hour and one-hour $PM_{2.5}$ concentrations in the Bow Corridor may also be different.[4]

Alberta does not have a one-hour or 24-hour guideline for PM_{10}. However, there is a 24-hour guideline for total suspended particulates of 100 $\mu g/m^3$. This 24-hour TSP guideline will be used for reference purposes in this report.

Results from $PM_{2.5}$ Monitoring in Exshaw

$PM_{2.5}$ data collected at the Exshaw station was compared to the 24-hour CWS benchmark concentration of 30 $\mu g/m^3$ and the one-hour equivalent concentration of 80 $\mu g/m^3$. $PM_{2.5}$ data from the Exshaw station is also presented relative to $PM_{2.5}$ data collected over the same time period at permanent air quality stations in Alberta. Hourly and 24-hour averaged particulate ($PM_{2.5}$ and PM_{10}) data collected at the Exshaw station are contained in Appendix B. There was a total of 307 days and 7394 hours of available $PM_{2.5}$ data collected from July 12, 2000 to July 3, 2001 at the Exshaw station.

Figure 2.3 shows monthly average and 24-hour maximum $PM_{2.5}$ data collected at the Exshaw station. Figure 2.4 shows time series of 24-hour average $PM_{2.5}$ concentrations at the Exshaw station and at some other monitoring stations in Alberta. The 24-hour benchmark concentration of 30 $\mu g/m^3$ was exceeded only once during the 307 day monitoring period. A 24-hour $PM_{2.5}$ concentration of 32 $\mu g/m^3$ was measured on August 18, 2000. Winds were from the south-southwest to west-northwest directions on this day with an average speed of 10 km/h. Daily average $PM_{2.5}$ concentrations were less than 30 $\mu g/m^3$ on the remainder of days monitored at the Exshaw station.

Table 2.1 indicates the dates, times and weather conditions when one-hour $PM_{2.5}$ concentrations were higher than the one-hour equivalent CWS benchmark concentration of 80 $\mu g/m^3$. $PM_{2.5}$ values higher than 80 $\mu g/m^3$ were recorded for five hours of the 7394 hours of data collected at

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[3] Canadian Council of Ministers of the Environment. 2001. *Guidance Document on Achievement Determination: Canada-wide Standards for Particulate Matter (PM) and Ozone.*

[4] Fu, L., K. Hunt, J. Ayers, B. Myrick and Y. Aklilu, 2000. *One-Hour Equivalent of a 24-Hour Average Particulate Matter Standard and its Potential Application in the Index of the Quality of the Air (IQUA).* Presented at the 2000 Annual Conference of the Canadian Pacific and Northern Section of the Air and Waste Management Association. June 2000.

the Exshaw station. One-hour values greater than 80 $\mu g/m^3$ were measured on July 22 (8 to 9 p.m.), July 31 (7 to 8 p.m.), October 4 (11 a.m. to noon) and November 10 (2 to 3 p.m.) of 2000, and February 12 (7 to 8 p.m.) of 2001. One-hour $PM_{2.5}$ levels ranged from 81 to 207 $\mu g/m^3$ during these five one-hour time periods. The maximum one-hour $PM_{2.5}$ concentration of 207 $\mu g/m^3$ was measured on October 4, 2000. Winds were from the east-northeast for two hours, and from the north, east and south for the remaining three hours when one-hour $PM_{2.5}$ values were higher than 80 $\mu g/m^3$.

Results from PM_{10} Monitoring in Exshaw

PM_{10} data collected at the Exshaw station was compared to Alberta's 24-hour TSP guideline of 100 $\mu g/m^3$. Data from permanent monitoring stations in Alberta is also presented for comparison purposes. There was a total of 59 days and 1416 hours of available PM_{10} data collected from July 3 to August 31, 2001 at the Exshaw station. PM_{10} data are presented in Figures 2.5 and 2.6.

24-hour PM_{10} concentrations exceeded the 24-hour TSP guideline once on August 22, 2001 with a reading of 107 $\mu g/m^3$. PM_{10} concentrations close to the 24-hour TSP guideline also occurred on August 13 (92 $\mu g/m^3$), August 17 (96 $\mu g/m^3$) and August 18 (90 $\mu g/m^3$). Elevated TSP levels on these days were primarily due to smoke from forest fires in the Kootenay National Park area of British Columbia.

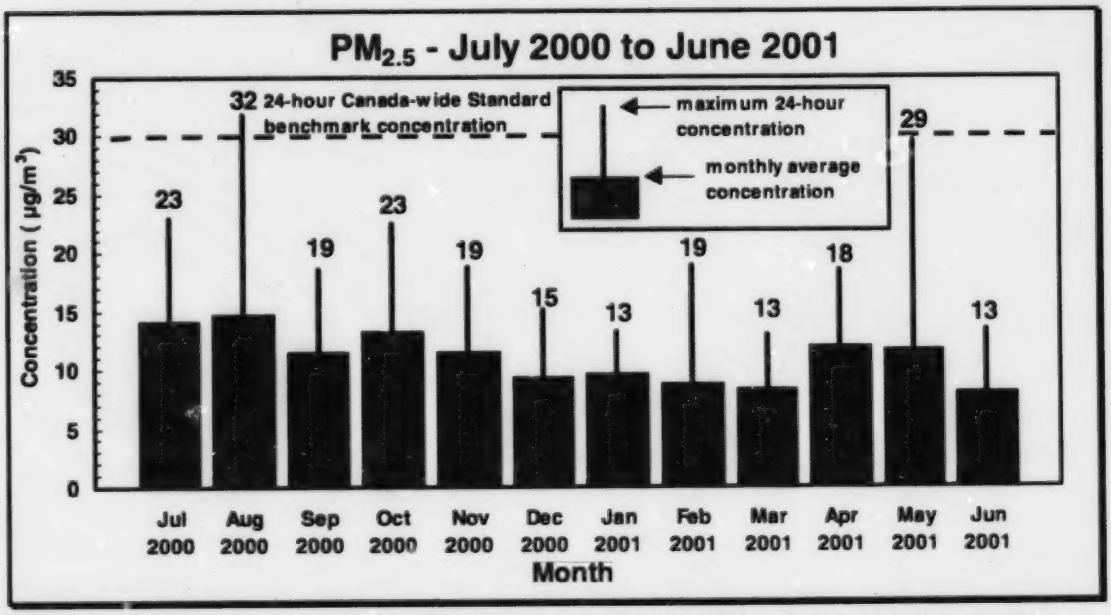


Figure 2.3 Monthly average and 24-hour maximum $PM_{2.5}$ data collected at the Exshaw station.

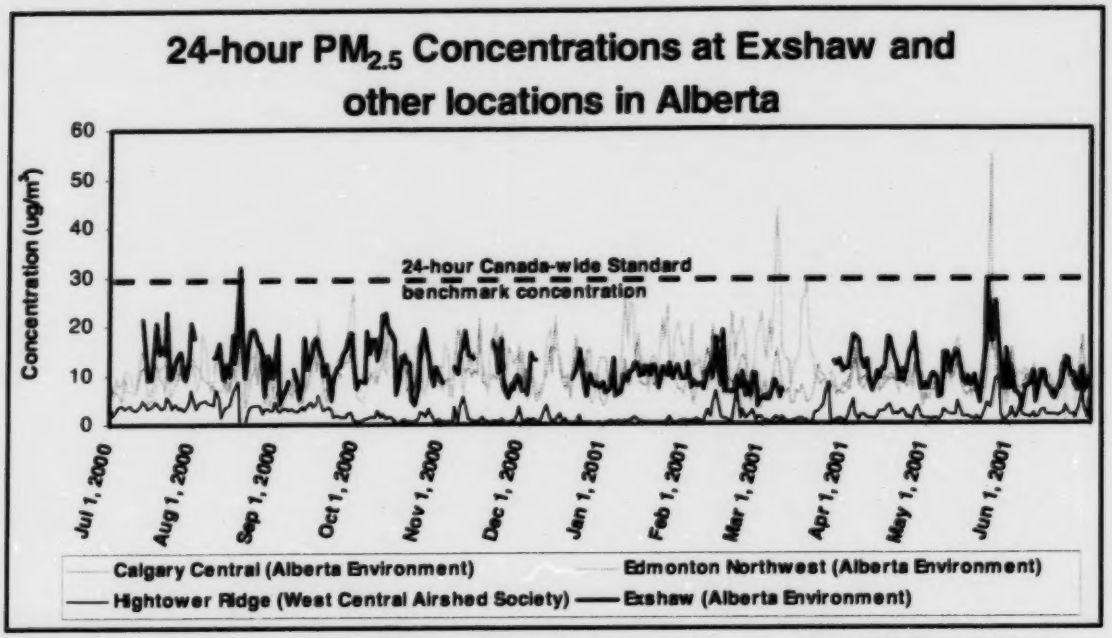


Figure 2.4 24-hour average $PM_{2.5}$ concentrations at the Exshaw station and at other Alberta monitoring stations.

Table 2.1 Date, time and weather conditions at the Exshaw air quality station when fine particulate (PM2.5) concentrations exceeded 80 µg/m³.

Date	Time	One-hour $PM_{2.5}$ Concentration (µg/m³)	Wind Direction	Wind Speed (km/h)	Temperature (°C)	Relative Humidity (%)
Oct 4, 2000	11 a.m to noon	207	east-northeast	12	-3.9	73
Jul 22, 2000	8 p.m. to 9 p.m.	174	north	2	24.3	44
Jul 31, 2000	7 p.m. to 8 p.m.	118	south	4	25.5	47
Feb 14, 2001	7 p.m. to 8 p.m.	81	east-northeast	16	-10.7	94
Nov 10, 2000	2 p.m. to 3 p.m.	81	east	11	-10.3	76

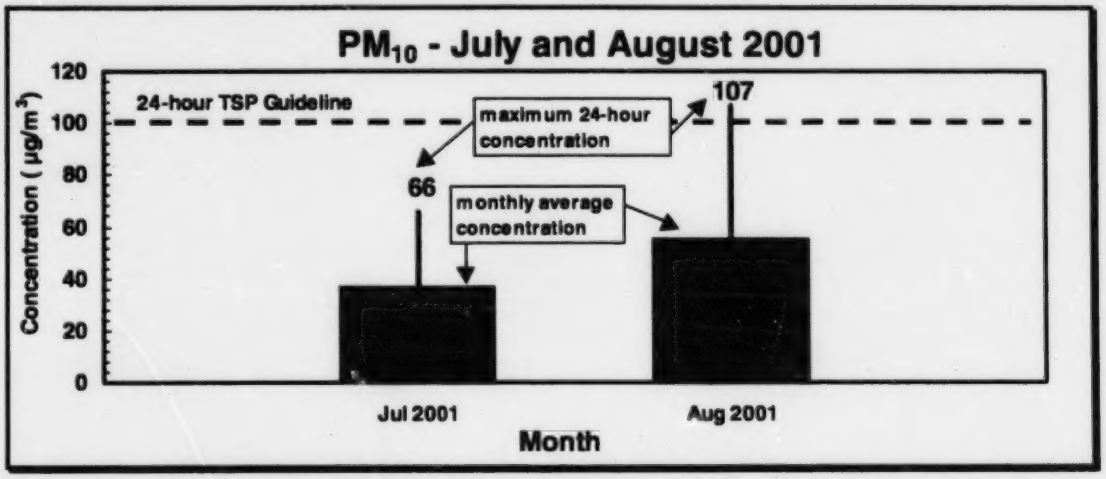


Figure 2.5 Monthly average and 24-hour maximum PM_{10} data collected at the Exshaw station.

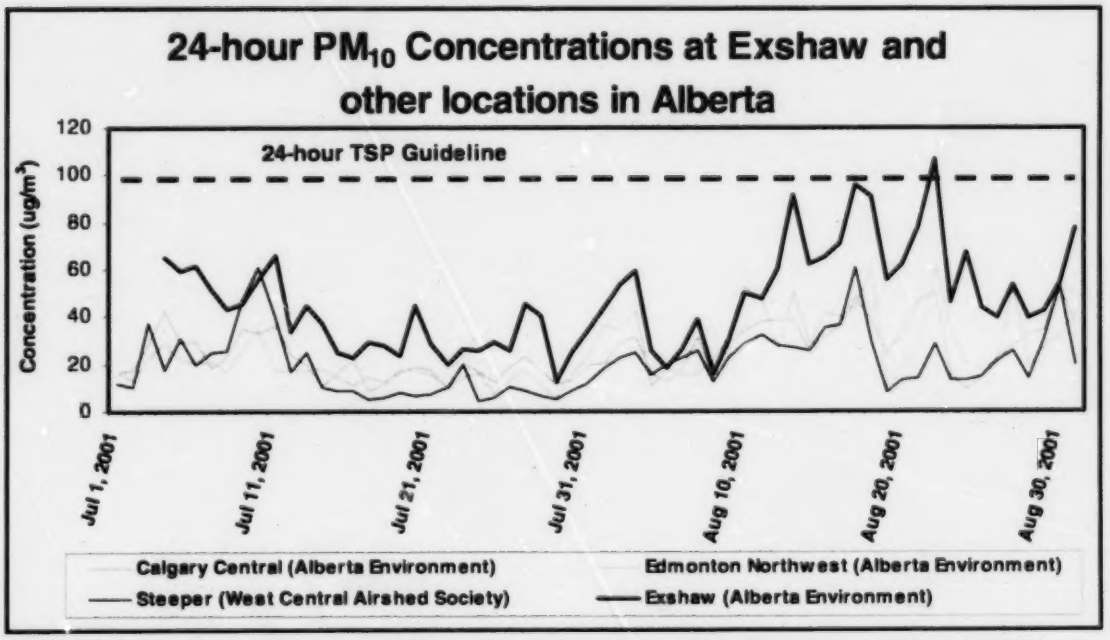


Figure 2.6 24-hour average PM_{10} concentrations at the Exshaw station and at other Alberta monitoring stations.

Comparison of $PM_{2.5}$ Levels in Exshaw with Other Alberta Locations

The overall average and maximum 24-hour $PM_{2.5}$ concentrations at the Exshaw station for the entire monitoring period are presented in Figure 2.7. This figure also shows $PM_{2.5}$ concentrations at other Alberta stations that have data from July 2000 to June 2001.

The overall average $PM_{2.5}$ concentration from July 2000 to June 2001 at the Exshaw station was 11.2 $\mu g/m^3$. This value is similar to the average over the same time period measured at the Edmonton Northwest monitoring station (11.4 $\mu g/m^3$) and slightly higher than average $PM_{2.5}$ level measured at the Calgary Central station (9.3 $\mu g/m^3$). Average $PM_{2.5}$ concentrations at the rural air quality stations of Tomahawk (80 km west of Edmonton) and Hightower Ridge (65 km northwest of Hinton) were 3.7 and 2.0 $\mu g/m^3$, respectively, based on data from July 2000 to June 2001. The West Central Airshed Society operates the Tomahawk and Hightower Ridge stations.

The maximum 24-hour $PM_{2.5}$ concentration measured at the Exshaw station was 32 $\mu g/m^3$. The maximum 24-hour $PM_{2.5}$ concentrations measured at the Edmonton Northwest and Fort McMurray stations from July 2000 to June 2001 were 55 and 32 $\mu g/m^3$, respectively. The maximum 24-hour concentration at the Calgary Central station was 22 $\mu g/m^3$. At the rural locations of Tomahawk and Hightower Ridge, the maximum 24-hour $PM_{2.5}$ concentration measured from July 2000 to June 2001 were 14 and 9 $\mu g/m^3$, respectively.

Comparison of PM_{10} Levels in Exshaw with Other Alberta Locations

Figure 2.8 shows the overall average and maximum 24-hour PM_{10} concentrations for July and August 2001 at the Exshaw station. Data for the same time period for the Calgary Central, Edmonton Northwest, Steeper (50 km south-southeast of Hinton), Tomahawk and Hightower Ridge stations are also presented in this figure.

PM_{10} concentrations at the Exshaw station were higher than other locations in Alberta for the July and August 2001 time period. The average PM_{10} concentration at the Exshaw station for this time period was 47 $\mu g/m^3$. This is almost double the average PM_{10} levels measured at the Calgary Central and Edmonton Northwest stations of 25 $\mu g/m^3$ at both stations. Average PM_{10} concentrations at the rural stations of Steeper and Tomahawk were 21 and 17 $\mu g/m^3$, respectively.

Maximum 24-hour PM_{10} levels were also higher at the Exshaw station. The maximum 24-hour PM_{10} concentration measured at the Exshaw station was 107 $\mu g/m^3$ compared to 52 $\mu g/m^3$ at the Calgary Central station and 61 $\mu g/m^3$ at the Edmonton Northwest station. The maximum 24-hour PM_{10} concentrations measured at the rural stations of Steeper and Tomahawk were of 61 and 57 $\mu g/m^3$, respectively, for the same time period.

Higher PM_{10} levels in Exshaw were likely due to the natural and industrial sources in the region. High PM_{10} values in August 2001 were partially due to smoke from a forest fire in the Kootenay National Park area. Elevated PM_{10} levels were also measured in Calgary from August 11 to 22 because of forest fire smoke. Other possible PM_{10} sources in the Exshaw area include natural wind-blown dust, near-by industrial facilities, vehicle exhaust emissions and recreational wood burning.

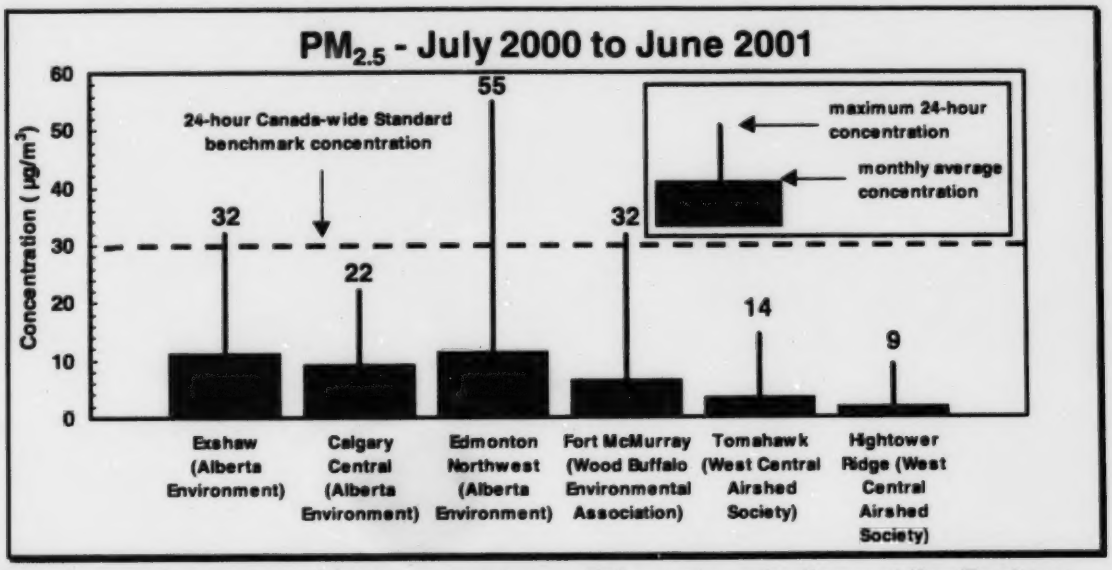


Figure 2.7 Average and 24-hour maximum $PM_{2.5}$ concentrations at the Exshaw station and at other Alberta monitoring stations from July 2000 to June 2001.

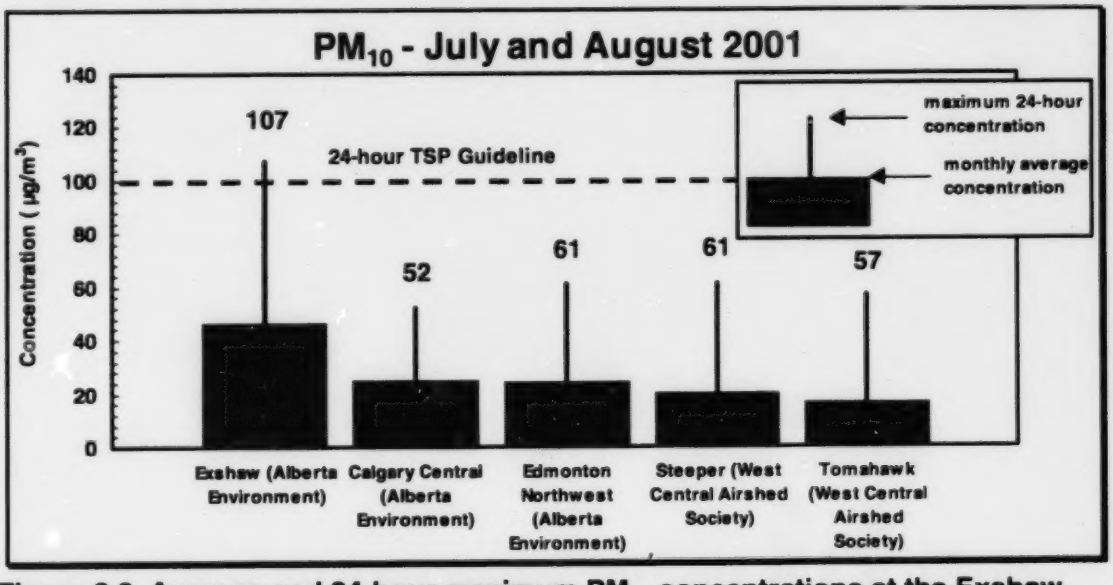


Figure 2.8 Average and 24-hour maximum PM_{10} concentrations at the Exshaw station and at other Alberta monitoring stations in July and August 2001.

Weather Data

Wind direction, wind speed, temperature and relative humidity were also monitored at the Exshaw station from July 12, 2000 to August 31, 2001. These data are presented in Figure 2.9 and Table 2.2.

Winds in the Exshaw area were primarily from the west-southwest to northwest directions from July 2000 to August 2001. Winds from these directions were measured 68 per cent of the time over this 12-month time period. The next most frequent wind directions were from the east to east-northeast with 18 per cent of the winds from these directions. This wind direction distribution was consistent throughout almost all of the months and conforms to the topographical orientation of the Bow River Valley.

Average wind speeds at the Exshaw station were lowest in the summer months and highest in the winter months. Average wind speeds in June, July and August were close to 10 km/h. From November to March, average wind speeds ranged from 14 to 18 km/h. Calm winds were recorded about one per cent of the time over the 12-month monitoring period.

Monthly average ambient temperatures at the Exshaw station ranged from -8.9 °C in February 2001 to 18.5 °C in July 2000. Average monthly temperatures were 10 °C or above in July, August and September 2000, and May to August 2001. Average temperatures were below 0 °C from November 2000 to March 2001.

Monthly average relative humidity values at the Exshaw station were generally lower in the spring and summer months and higher in the winter months. Average relative humidity values less than 50% were measured in July 2000, May 2001 and August 2001. Average relative humidity values were greater than 70% in November and December 2000.

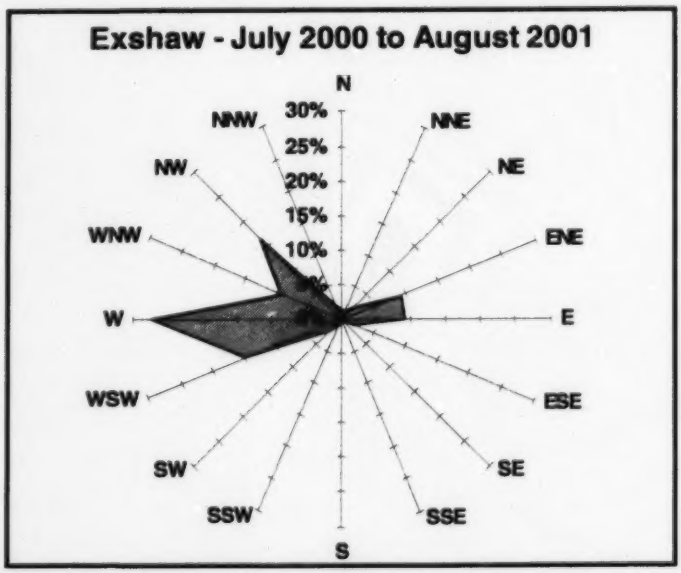


Figure 2.9 Wind direction frequency distribution at the Exshaw air quality station from July 2000 to August 2001.

Table 2.2 Weather conditions at the Exshaw air quality station from July 2000 to August 2001.

Month	Predominant Wind Directions	Average Wind Speed (km/h)	Average Temperature (°C)	Average Relative Humidity (%)
July, 2000	southwest to northwest	9.9	18.5	49.1
August, 2000	west-southwest to west-northwest	8.9	14.5	56.2
September, 2000	west-southwest to west, east-northeast	12.3	10.0	60.5
October, 2000	west-southwest to west, east	12.5	5.4	60.4
November, 2000	west-southwest to northwest	15.0	-4.3	70.6
December, 2000	west-southwest to northwest, east to east-northeast	15.4	-8.4	72.7
January, 2001	west-southwest to northwest	18.0	-2.6	62.1
February, 2001	west-southwest to northwest, east to east-northeast	13.6	-8.9	69.3
March, 2001	west-southwest to northwest, east	14.1	-0.2	56.6
April, 2001	west-southwest to west, east	11.5	3.1	63.9
May, 2001	west-southwest to west	13.4	10.7	44.3
June, 2001	west-southwest to northwest, east to east-northeast	10.1	11.4	65.7
July, 2001	west-southwest to northwest, east to east-northeast	10.6	16.7	57.0
August, 2001	west-southwest to northwest, east to east-northeast	9.7	18.1	44.2

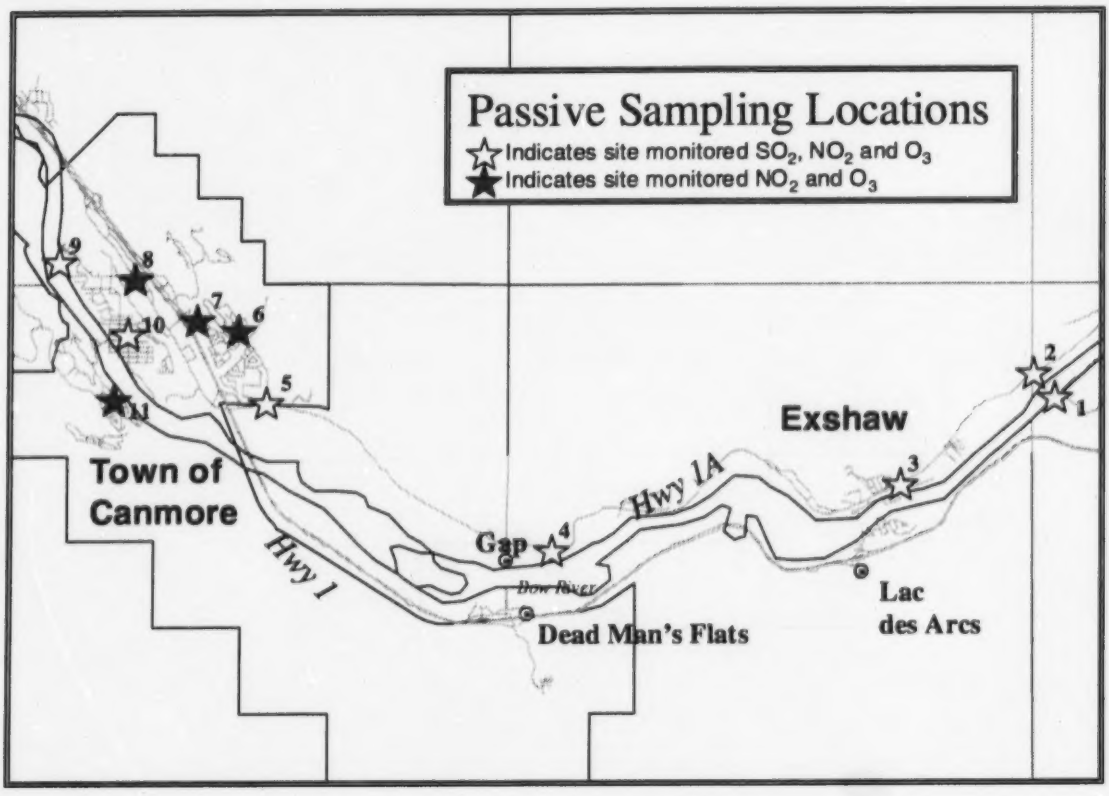
Part 3: Monitoring Using Passive Samplers

Sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and ozone (O_3) were monitored on a monthly basis in the Bow Corridor using passive samplers. The passive monitoring network covered a geographical area from the Bow Valley Provincial Park to Canmore (see Figure 3.1).

Passive SO_2 samples were collected at seven sites over a 12-month period from July 2000 to June 2001. Passive NO_2 and O_3 samples were collected at eleven locations over the same 12-month period. Passive data were used primarily to: (1) determine the spatial variation of SO_2, NO_2 and O_3 in the Bow Corridor, and (2) compare SO_2 and NO_2 levels over the 12-month monitoring period with Alberta's annual guidelines. The annual guideline for SO_2 is 11 parts per billion (ppb) and the annual guideline for NO_2 is 32 ppb.

Monitoring Method

Passive monitoring methods provide a cost-effective solution for monitoring air quality at locations where continuous monitoring is not practical. This method of monitoring uses a passive sampling device (PSD) to monitor air pollutants without the need for electricity, data loggers or pumps. The PSD is a lightweight, portable sampler that works by the physical process of diffusion. No active movement of air through the sampler is necessary. Air pollutants diffuse through a membrane, and collect on a filter, which has been specifically coated to absorb the pollutant of interest. The entire assembly is sent to a laboratory to be analyzed for the amount of pollutant on the filter. From this value, the average ambient concentration of pollutant is calculated using an empirical formula that takes into account the effects of temperature, humidity and wind speed. The disadvantage of using passive systems is that samples are collected over a one month time period and therefore events that last for short time periods are "averaged out".



Site #	Location	Latitude (degrees)	Longitude (degrees)	Elevation (metres)	Parameters Monitored
1	Bow Provincial Park (Bow River parking area)	51.08	115.11	1304	SO_2 NO_2 O_3
2	Burnco gate (12 m south of gate)	51.08	115.12	1325	SO_2 NO_2 O_3
3	Exshaw (Heart Mountain Dr.)	51.06	115.15	1315	SO_2 NO_2 O_3
4	Bighorn Meadow (50 m north of trail)	51.05	115.24	1336	SO_2 NO_2 O_3
5	Canmore (Elk Run Blvd.)	51.08	115.32	1348	SO_2 NO_2 O_3
6	Canmore (Benchlands Trail)	51.09	115.33	1420	NO_2 O_3
7	Canmore (200 m from Hwy #1 overpass)	51.09	115.34	1347	NO_2 O_3
8	Canmore (17th St.)	51.10	115.36	1340	NO_2 O_3
9	Canmore (Larch Cr.)	51.10	115.38	1331	SO_2 NO_2 O_3
10	Canmore (8th St. an 6th Ave.)	51.09	115.36	1332	SO_2 NO_2 O_3
11	Canmore (Prospect Heights)	51.08	115.36	1352	NO_2 O_3

Figure 3.1 Location of passive monitoring sites in the Bow Corridor survey.

The passive samplers used for monitoring in the Bow Corridor survey were the *All Season SO_2 Passive Sampler*, the *All Season NO2 Passive Sampler* and the *All Season O_3 Passive Sampler* developed by Maxxam Analytics. The three samplers use the same basic design consisting of a polycarbonate body, about five centimetres in diameter. The sampling media and a support ring are enclosed in the body. In order to reduce interference by particulate matter and condensation, the sampler was designed to be installed face down in a rain shelter. The diffusion barrier is a Teflon film resembling a piece of lightweight paper that is held in place across the face of the sampler by a plastic ring.

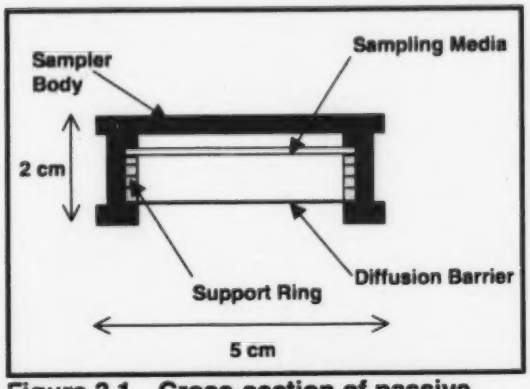


Figure 3.1 Cross-section of passive sampler.

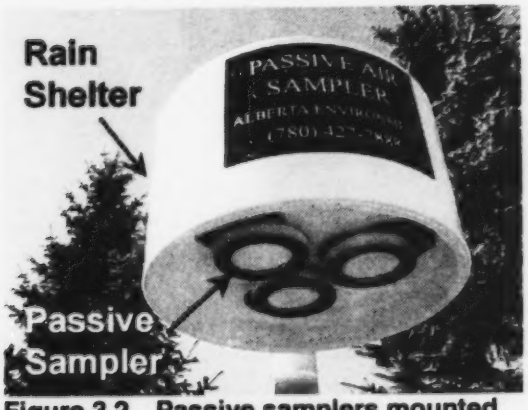


Figure 3.2 Passive samplers mounted inside rain shelter.

Meteorological factors, such as wind speed, temperature, and relative humidity are important when calculating ambient concentrations from passive samplers. These factors will affect the sampling rate of SO_2, NO_2 and O_3 on to the collection media of the passive sampler. Meteorological information used to calculate SO_2, NO_2 and O_3 concentrations from passive samplers are based on data from the Exshaw air quality station. These data are presented in Part 2 of this report (see Figure 2.6 and Table 2.2).

Results from the Passive Sulphur Dioxide (SO_2) Monitoring Network

Alberta Environment monitored for SO_2 using passive samplers at seven sites in the Bow Corridor from July 2000 to June 2001. Monthly and 12-month average SO_2 concentrations are presented for each monitoring site in Table 3.1, Figure 3.3 and Figure 3.4.

12-month average SO_2 levels were below Alberta Environment's annual guideline of 11 ppb at all passive sites in the Bow Corridor. The highest 12-month average SO_2 concentration was 4.4 ppb measured at Site #3 located on Heart Mountain Drive in Exshaw. This value is 40% of the annual guideline. The next highest 12-month average concentrations were measured at Site #2 (Burnco gate) and Site #1 (Bow Valley Provincial Park) where annual average values were 2.9 and 2.4 ppb, respectively. Sites #3, #2 and #1 are the eastern-most passive monitoring stations. The four western-most passive monitoring stations located at Bighorn Meadow and Canmore recorded lower SO_2 concentrations with annual average values ranging from 0.9 to 1.2 ppb.

Table 3.1 Average and maximum monthly sulphur dioxide concentrations (ppb) from passive monitoring sites in the Bow Corridor.

Site	Jul 2000	Aug 2000	Sep 2000	Oct 2000	Nov 2000	Dec 2000	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	Jun 2001	12-month Average*
#1	3.2	2.9	5.1	2.6	1.0	6.1	0.4	0.8	0.7	1.5	2.9	1.6	2.4
#2	4.2	4.7	5.2	3.5	3.7	4.0	0.7	1.3	0.9	1.8	3.1	2.4	2.9
#3	6.2	5.6	7.3	2.8	5.5	6.0	1.1	1.4	1.7	3.6	7.7	4.4	4.4
#4	1.3	1.7	1.0	1.6	1.1	1.2	0.3	1.3	0.5	0.9	0.6	1.0	1.0
#5	1.0	1.3	1.2	1.4	1.1	1.2	0.3	1.4	0.6	0.7	0.3	0.7	0.9
#9	0.6	0.8	0.8	1.0	n/a	0.9	0.2	1.4	n/a	0.6	0.2	0.5	0.7
#10	1.0	1.2	1.1	1.5	1.1	1.2	0.3	1.8	0.6	0.7	0.4	0.8	1.0
Average	**2.5**	**2.6**	**3.1**	**2.1**	**2.2**	**2.9**	**0.5**	**1.3**	**0.8**	**1.4**	**2.2**	**1.6**	**1.9**

n/a Indicates sample was missing, damaged or destroyed.

* **The annual guideline for SO_2 is 11 ppb.**

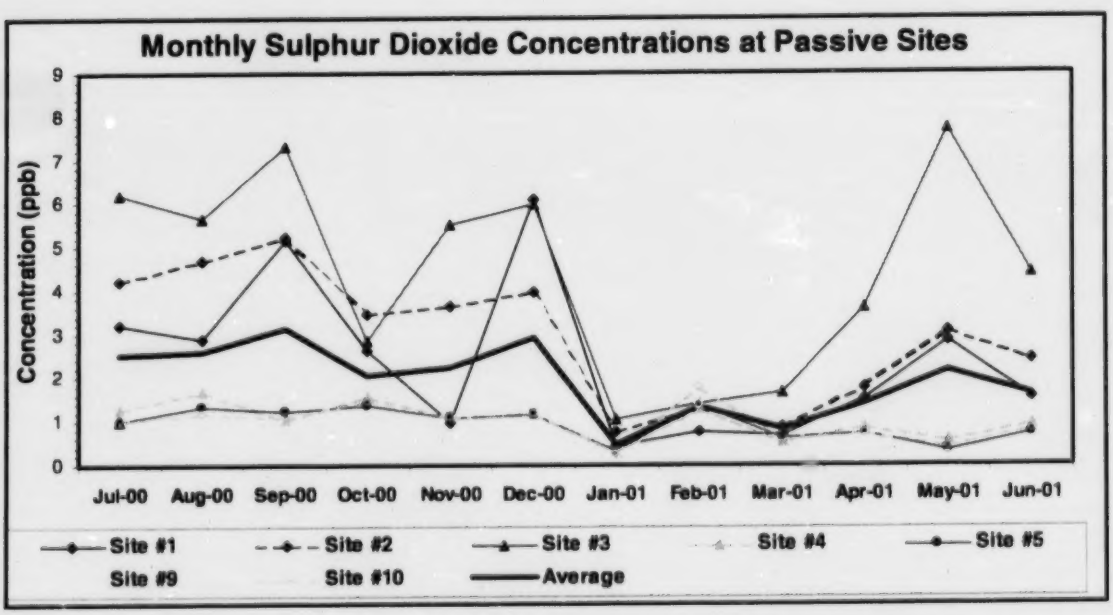


Figure 3.3 Monthly variation in sulphur dioxide concentrations (ppb) at passive monitoring sites in the Bow Corridor.

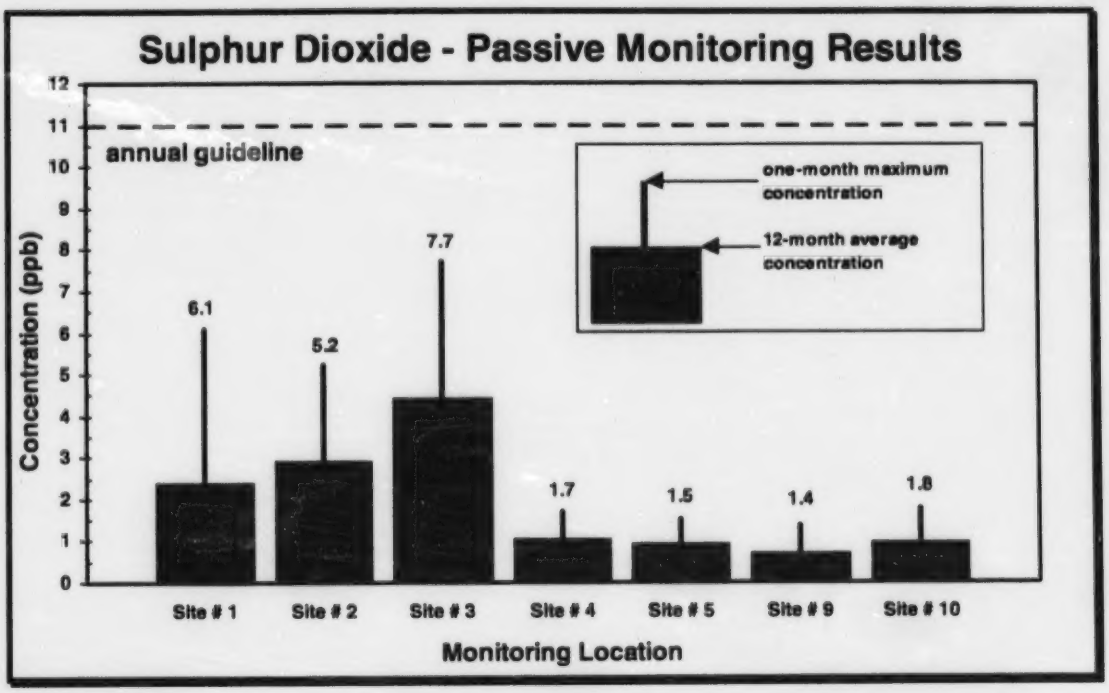


Figure 3.4 Average and maximum monthly sulphur dioxide concentrations (ppb) at passive monitoring sites in the Bow Corridor.

Monthly SO_2 concentrations in the Bow Corridor were also lower than Alberta's annual guideline of 11 ppb. Alberta does not have a monthly guideline for SO_2. The highest monthly SO_2 concentration of 7.7 ppb was measured at Site #3. SO_2 concentrations were consistently higher at this site than at the other six locations. However, monthly SO_2 levels higher than 5 ppb were also measured at Sites #1 and #2.

SO_2 concentrations did show somewhat of a seasonal variation based on passive sampling results. Based on average values for all seven stations, the lowest SO_2 concentrations were measured from January to April (0.5 to 1.4 ppb). The highest monthly average SO_2 concentrations for all stations were measured from July to September (2.5 to 3.1 ppb). Industrial facilities in the Exshaw area (Lafarge Cement Manufacturing Plant, Baymag Magnesia Manufacturing Plant and Graymont Lime Plant) are not required to continuously monitor SO_2 emissions from their respective facilities. Therefore, monthly SO_2 data from the passive network cannot be compared directly with monthly SO_2 emissions from these facilities. However, facilities in the Exshaw are required to report annual SO_2 emissions greater than 10 tonnes per year.

Comparison of SO_2 Results from the Bow Corridor Passive Network with Other Locations in Alberta

Figure 3.5 shows passive SO_2 concentrations averaged over the 12-month monitoring period (July 2000 to June 2001) from the Bow Corridor passive network and from 20 continuous SO_2 monitoring stations located throughout the province. These data are obtained from the CASA data warehouse at (http://www.casadata.org).

The average SO_2 concentration from the passive network in the Bow Corridor over the 12-month monitoring period was 1.9 ppb. This value is lower than the average SO_2 concentration recorded over the same time period at the Calgary East, Edmonton East, Sherwood Park and Mildred Lake (40 km north of Fort McMurray) stations. Average SO_2 concentrations at these stations ranged from 2.2 to 3.0 ppb from July 2000 to June 2001. The 12-month average SO_2 concentration at the remaining 16 monitoring stations presented in Figure 3.4 ranged from 0.1 to 2.0 ppb. Background SO_2 levels in Alberta for this time period were from 0.1 to 0.2 ppb based on data from the Steeper (50 km south-southeast of Hinton) and Hightower Ridge (65 km northwest of Hinton) stations.

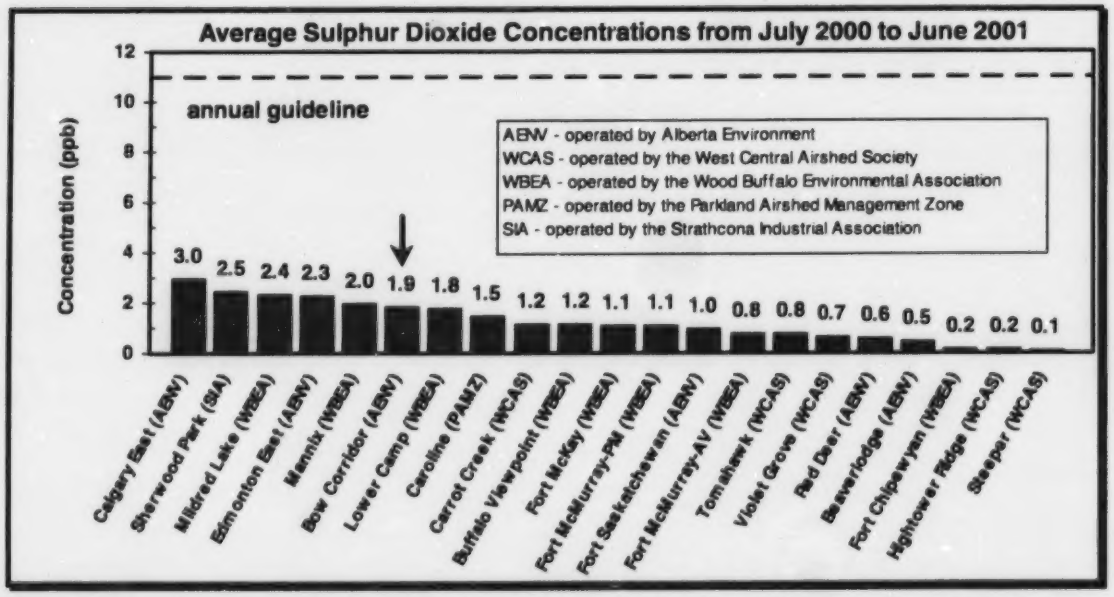


Figure 3.5 Average sulphur dioxide concentrations in the Bow Corridor and at other Alberta monitoring stations from July 2000 to June 2001.

Results from the Passive Nitrogen Dioxide (NO_2) Monitoring Network

Nitrogen dioxide, or NO_2, was monitored using passive samplers at eleven sites in the Bow Corridor from July 2000 to June 2001. Monthly NO_2 concentrations from this network are presented in Table 3.3 and Figures 3.6 and 3.7.

12-month average NO_2 concentrations were below Alberta Environment's annual guideline of 32 ppb at all eleven passive NO_2 monitoring stations in the Bow Corridor. The highest 12-month average NO_2 concentration of 17.1 ppb was measured at Site #10 (8th Street and 6th Avenue in Canmore). This value is about 53% of the annual guideline for NO_2. The next highest annual average NO_2 values were recorded at Site #3 (Heart Mountain Drive in Exshaw), Site #5 (Elk Run Boulevard in Canmore) and Site #8 (17th Street in Canmore). Annual average concentrations at these three sites were 13.7, 12.4 and 12.4 ppb, respectively. Higher NO_2 concentrations at Canmore monitoring locations are likely due to exhaust emissions from local traffic. At Site #3, located in Exshaw, NO_2 concentrations are likely influenced by near-by industrial activities. 12-month average NO_2 concentrations at the other passive monitoring stations ranged from 5.4 ppb to 11.3 ppb.

The highest monthly NO_2 concentration of 25.8 ppb was measured at Site #10 in October of 2000. Monthly NO_2 values of 20 ppb or higher were also measured at Site #3, Site #5 and Site #8. Alberta does not have a monthly guideline for NO_2. However, the maximum monthly concentration measured from the passive network was lower than the annual guideline for NO_2.

Based on average values from all stations, NO_2 concentrations were highest from July to October 2000. Monthly average NO_2 levels from all stations ranged from 12.3 to 16.1 ppb during these months. It should also be noted that oxides of nitrogen (NOx) emissions from the Lafarge Cement Manufacturing Plant were also substantially higher in July and August than during the remainder of the monitoring period (see Table 3.2). The lowest concentrations were generally recorded in January, April, May and June 2001 when average NO_2 levels from all stations ranged from 6.7 to 9.7 ppb.

Table 3.2 Oxides of nitrogen emissions from the Lafarge Cement Manufacturing Plant (tonnes).*

Facility	Jul 2000	Aug 2000	Sep 2000	Oct 2000	Nov 2000	Dec 2000
Lafarge Cement Manufacturing Plant (Kiln #4)	265	162	118	115	97	140
Lafarge Cement Manufacturing Plant (Kiln #5)	159	79	58	28	89	43
Total from Lafarge Cement Manufacturing Plant	423	241	175	142	186	182
Facility	**Jan 2001**	**Feb 2001**	**Mar 2001**	**Apr 2001**	**May 2001**	**Jun 2001**
Lafarge Cement Manufacturing Plant (Kiln #4)	144	77	124	50	59	105
Lafarge Cement Manufacturing Plant (Kiln #5)	0	0	0	109	125	93
Total from Lafarge Cement Manufacturing Plant	144	77	124	159	184	197

* - Monthly oxides of nitrogen emissions are obtained from monthly reports provided by industry.
n/a – indicates data is not available.

Table 3.3 Average and maximum monthly nitrogen dioxide concentrations (ppb) from passive monitoring sites in the Bow Corridor.

Site	Jul 2000	Aug 2000	Sep 2000	Oct 2000	Nov 2000	Dec 2000	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	Jun 2001	12-month Average*
#1	16.1	14.6	14.2	n/a	12.9	11.3	10.7	7.3	10.7	7.5	12.6	6.7	11.3
#2	15.1	15.9	15.6	14.5	11.7	10.2	6.6	7.9	7.2	9.0	11.4	6.2	10.9
#3	20.3	20.6	17.9	18.4	10.2	8.9	9.8	5.9	13.8	11.1	18.0	10.0	13.7
#4	8.4	10.2	9.1	10.3	9.9	6.3	7.7	8.2	5.2	9.4	7.1	5.1	8.1
#5	16.1	14.0	13.2	20.0	11.8	10.3	9.2	19.0	14.0	7.8	6.0	7.3	12.4
#6	8.5	n/a	8.4	13.7	11.7	10.2	5.8	10.4	7.9	7.6	8.2	7.0	9.0
#7	9.4	12.4	11.8	19.5	13.6	13.1	10.9	13.0	9.4	8.7	6.9	5.7	11.2
#8	13.9	14.9	14.5	20.1	7.9	6.6	11.3	16.5	12.9	13.4	8.9	8.2	12.4
#9	n/a	7.5	5.0	9.9	3.9	3.3	4.8	n/a	n/a	5.5	n/a	3.2	5.4
#10	22.4	24.4	19.7	25.8	n/a	16.7	12.7	14.6	19.9	5.7	15.1	11.1	17.1
#11	4.9	6.2	6.2	8.4	11.0	13.0	5.5	8.9	4.6	3.7	3.1	3.1	6.6
Average	13.5	14.1	12.3	16.1	10.5	10.0	8.6	11.2	10.6	8.1	9.7	6.7	10.9

n/a Indicates sample was missing, damaged or destroyed.

* **The annual guideline for NO_2 is 32 ppb.**

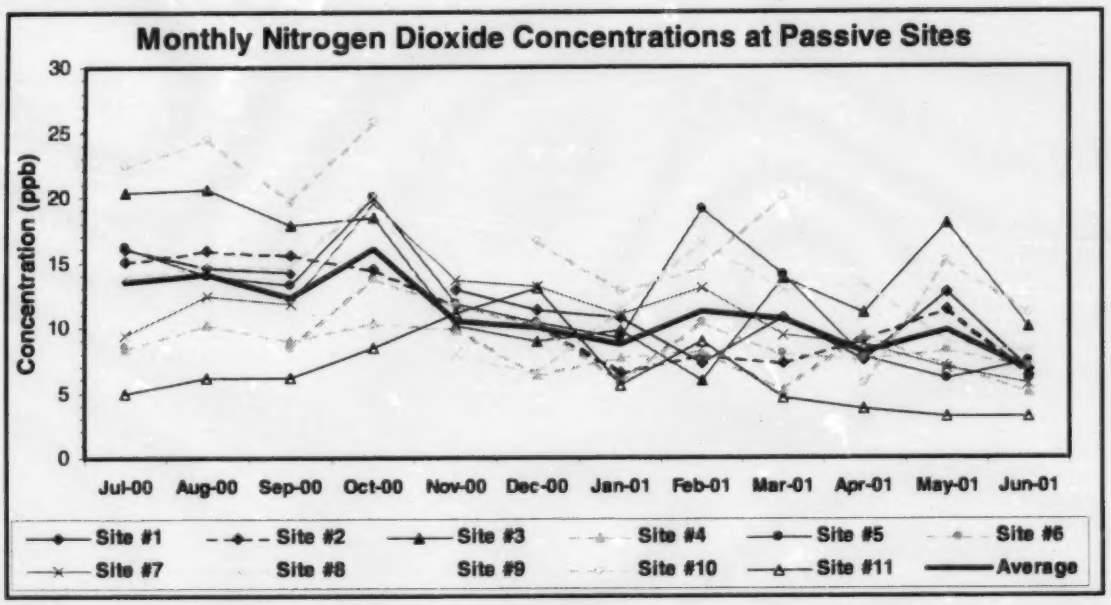


Figure 3.6 Monthly variation in nitrogen dioxide concentrations (ppb) at passive monitoring sites in the Bow Corridor.

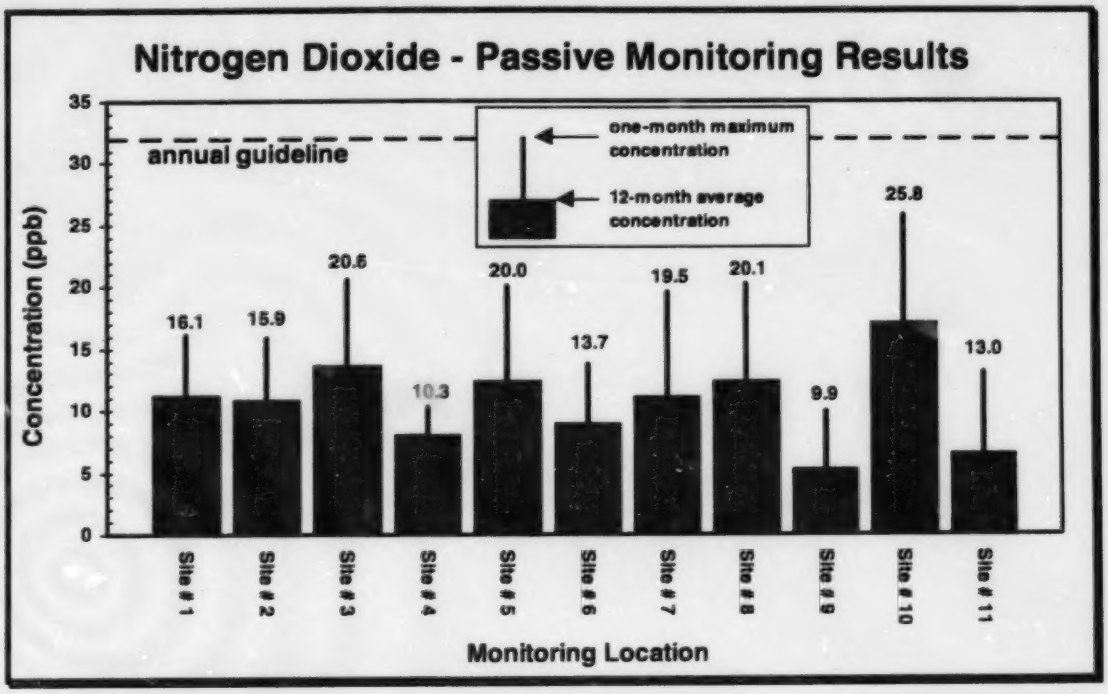


Figure 3.7 Average and maximum monthly nitrogen dioxide concentrations (ppb) at passive monitoring sites in the Bow Corridor.

Comparison of NO_2 Results from the Bow Corridor Passive Network with Other Locations in Alberta

Average NO_2 concentrations from July 2000 to June 2001 were close to those measured at smaller urban centres in Alberta (Figure 3.8). The average NO_2 concentration from all stations in the Bow Corridor was 10.9 ppb. This is in the range of those measured in Red Deer, Fort Saskatchewan and Fort McMurray (Athabasca Valley station) for the same time period. Average NO_2 values at these locations ranged from 9.3 to 13.1 ppb.

NO_2 levels in the Bow Corridor were much lower than those at larger urban centres such as Edmonton and Calgary. Average NO_2 concentrations in Edmonton and Calgary from July 2000 to June 2001 ranged from 15.4 ppb at the Calgary Northwest station to 26.0 ppb at the Calgary Central station. Vehicle exhaust is the major NO_2 source at urban locations in Alberta.

Based on data from the Hightower Ridge (65 km northwest of Hinton) and Fort Chipewyan stations, rural background NO_2 concentration for this time period in Alberta were less than 1 ppb.

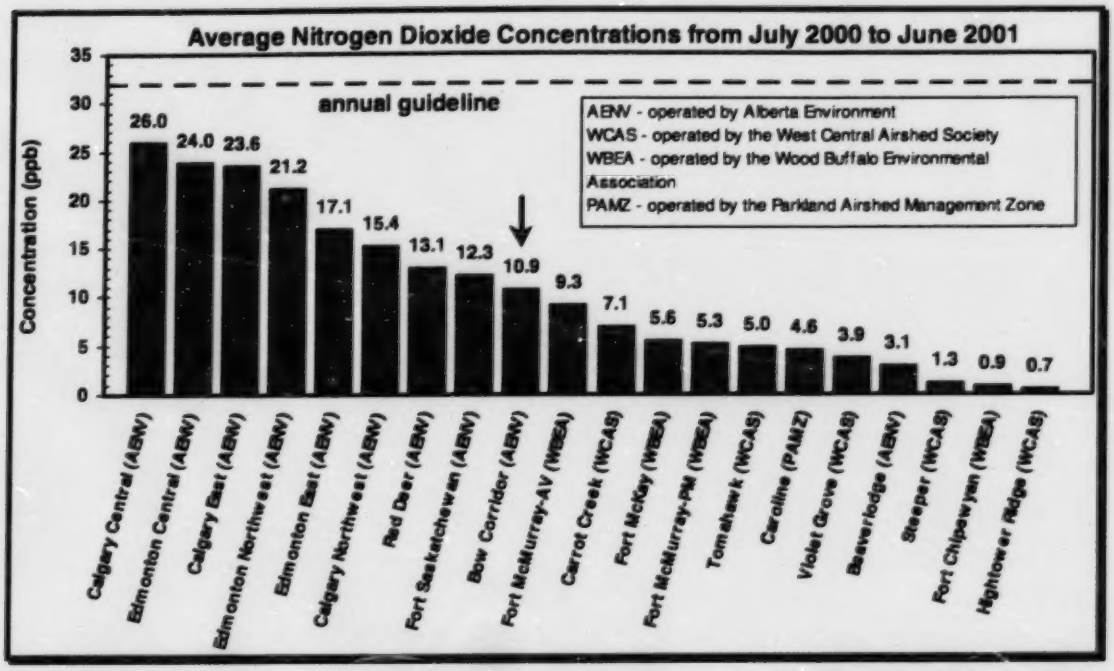


Figure 3.8 Average nitrogen dioxide concentrations in the Bow Corridor and at other Alberta monitoring stations from July 2000 to June 2001.

Results from the Passive Ozone (O_3) Monitoring Network

O_3 was measured using passive samplers at eleven sites in the Bow Corridor. The results of the 12-month sampling program are presented in Table 3.4, Figure 3.9 and Figure 3.10.

High levels of O_3 at rural locations in Alberta occur because of natural O_3 generating processes. In the fall, winter and early spring, most of the O_3 at ground level is the result of transport from the "ozone-rich" upper atmosphere through natural meteorological processes. Natural O_3 is also produced through chemical reactions involving organic compounds (primarily from vegetation) and oxides of nitrogen. These chemical reactions need sunlight and heat to occur and therefore are more prevalent in the late spring and summer seasons. Ground-level O_3 concentrations are usually lower in large urban centres, such as Edmonton and Calgary, because of the destruction of natural O_3 by nitric oxide emitted from automobiles and other sources.[5]

O_3 levels from the Bow Corridor showed typical seasonal variations that are observed at other locations in Alberta. Based on monthly averages, the highest O_3 levels were measured in spring season and the lowest were recorded in the fall and early winter. The average O_3 concentrations for all stations were highest from March to May when average values from 32 to 35 ppb were measured. This is in contrast to average concentrations ranging from 14 to 17 ppb in the months of September to December.

[5] Angle, R.P and H.S. Sandhu. 1989. *Urban and rural ozone concentrations in Alberta, Canada.* Atmospheric Environment 23: 215-221.

Overall average O_3 concentrations from July 2000 to June 2001 were relatively consistent between monitoring sites ranging from 20 to 25 ppb. The only exception was Site #1 (Bow Valley Provincial Park) where the average for the 12-month monitoring period was 16 ppb. Monthly O_3 levels at Site #1 were consistently lower than at the other ten sites. Lower average O_3 levels at this location may have been due to the location of the station furthest east and at a slightly lower elevation than the other sites. Also, nitric oxide emitted by vehicles and industries in the area may have contributed to lower O_3 levels at Site #1. In general, O_3 levels from natural processes are higher in more mountainous terrain and at higher elevations.

Table 3.4 Monthly average ozone concentrations from passive samplers in the Bow Corridor survey (ppb).

Site	Jul 2000	Aug 2000	Sep 2000	Oct 2000	Nov 2000	Dec 2000	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	Jun 2001	12-month Average
#1	13.1	13.7	7.0	13.4	13.3	11.3	16.6	12.3	23.4	25.3	28.1	14.5	16.0
#2	22.2	20.1	16.5	21.1	20.9	20.2	25.8	14.1	39.7	36.4	38.2	21.7	24.8
#3	16.8	14.0	10.6	17.5	17.3	17.3	20.0	15.1	31.7	30.0	31.0	17.6	19.9
#4	21.5	19.3	15.0	22.2	16.3	15.0	18.7	13.9	30.1	33.6	43.2	21.2	22.5
#5	23.3	20.6	15.4	18.1	17.9	17.5	19.4	13.6	35.1	34.2	38.3	23.1	23.0
#6	22.4	24.4	15.3	17.2	17.0	16.4	22.4	17.1	31.4	32.7	35.8	20.5	22.7
#7	20.7	18.6	14.1	13.3	13.2	12.5	26.6	16.5	33.7	33.6	37.1	20.5	21.7
#8	19.1	15.9	11.7	14.6	14.5	14.3	20.0	13.3	31.3	30.7	33.9	21.0	20.0
#9	n/a	21.7	15.6	17.9	17.7	17.3	19.6	15.9	n/a	33.0	31.7	21.6	21.2
#10	19.7	19.1	12.2	16.5	16.3	16.0	20.2	14.8	28.3	29.4	33.5	20.2	20.5
#11	22.9	21.8	15.9	19.5	19.3	18.0	22.1	13.5	32.9	35.5	36.9	22.1	23.4
Average	**20.2**	**19.0**	**13.6**	**17.4**	**16.7**	**16.0**	**21.0**	**14.6**	**31.8**	**32.2**	**35.3**	**20.4**	**21.4**

n/a Indicates sample was missing, damaged or destroyed.

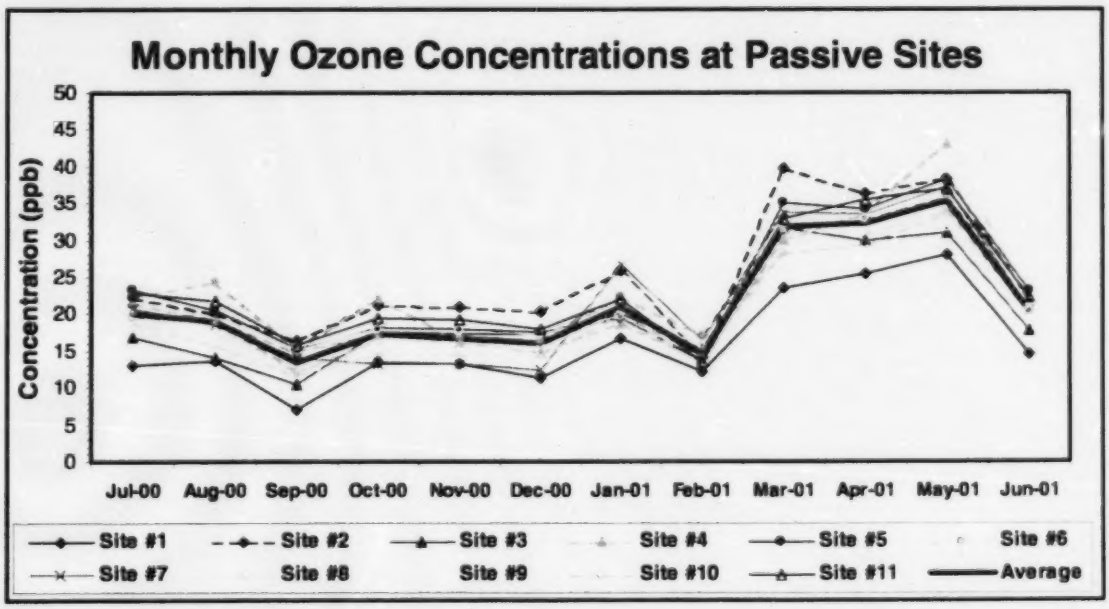


Figure 3.9 Monthly variation in ozone concentrations (ppb) at passive monitoring sites in the Bow Corridor.

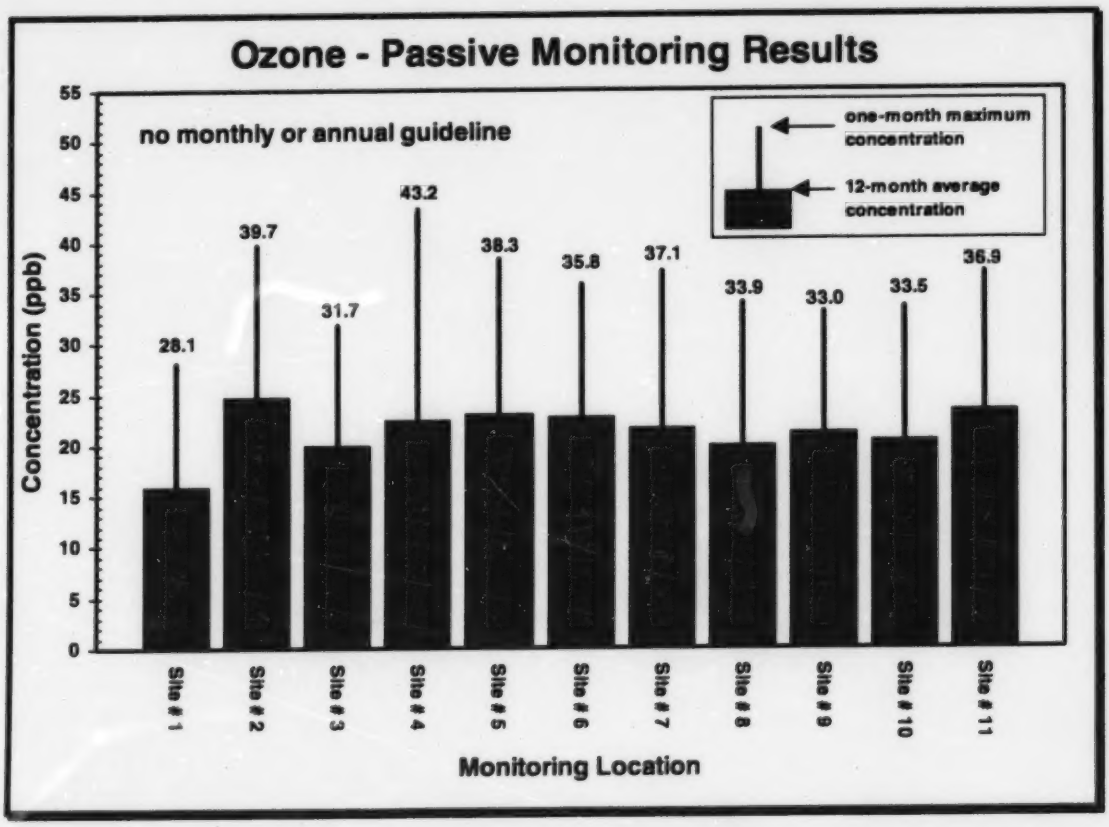


Figure 3.10 Average and maximum monthly ozone concentrations (ppb) at passive monitoring sites in the Bow Corridor.

Comparison of O_3 Results from the Bow Corridor Passive Network with Other Locations in Alberta

The overall average O_3 concentration in the Bow Corridor was 21 ppb. This value is similar to values measured at small urban communities in the province. At monitoring stations in Red Deer, Fort Saskatchewan and Fort McMurray, average O_3 levels from July 2000 to June 2001 ranged from 18 to 22 ppb.

The average O_3 concentration in the Bow Corridor was somewhat lower than those measured at rural locations in Alberta for the same time period. At monitoring locations such as Beaverlodge, Caroline, Fort Chipewyan and the five stations in the West Central Airshed Zone, average O_3 levels from July 2000 to June 2001 ranged from 28 to 45 ppb. The highest O_3 concentrations were measured at the western-most stations in the West Central Airshed Zone of Hightower Ridge (65 km northwest of Hinton) and Steeper (50 km south-southeast of Hinton). O_3 levels at urban stations located in downtown Edmonton and Calgary were much lower than those measured in the Bow Corridor because of the destruction of natural O_3 by nitric oxide emitted by vehicles.

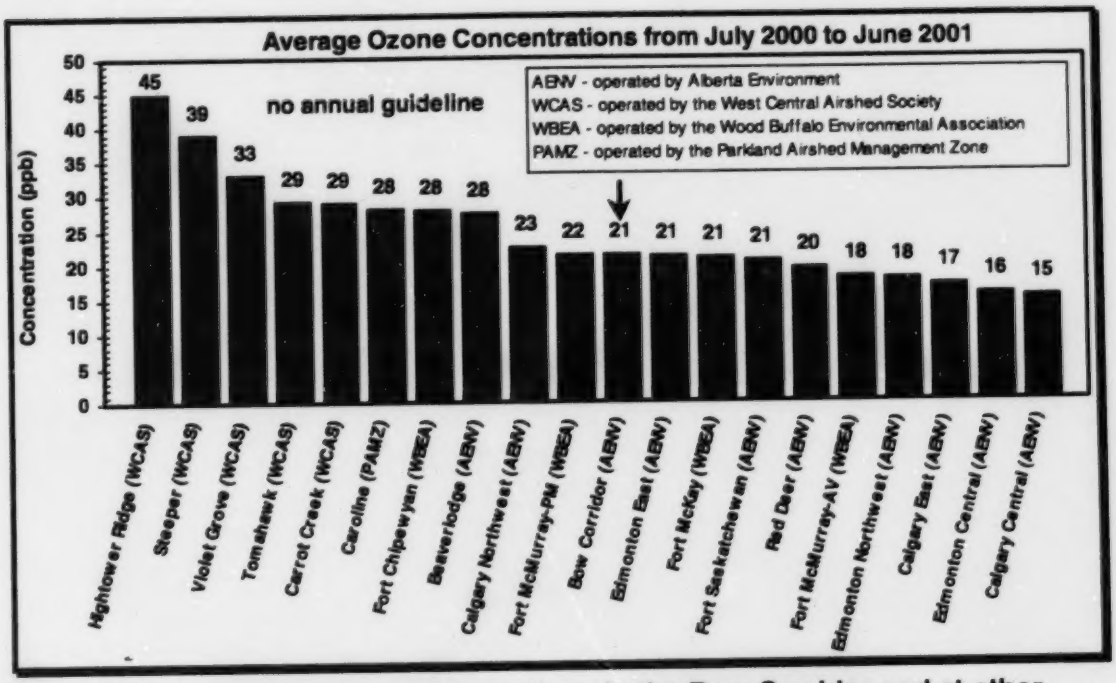


Figure 3.11 Average ozone concentrations in the Bow Corridor and at other Alberta monitoring stations from July 2000 to June 2001.

Appendix A – Data Collected by the Mobile Air Monitoring Laboratory

Table A.1 Median one-hour air quality parameter concentrations at each mobile monitoring site in the Bow Corridor (December 1999 to September 2000).

Area	Site (# of hours monitored)	CO ppm	O_3 ppm	THC ppm	CH_4 ppm	RHC ppm	SO_2 ppm	NO ppm	NO_2 ppm	NO_X ppm	NH_3 ppm	TRS ppm	H_2S ppm	TSP $\mu g/m^3$	PM_{10} $\mu g/m^3$	$PM_{2.5}$ $\mu g/m^3$	PAH ng/m^3
Banff	Site # 1 (2)	0.4	0.028	1.8	1.7	0.1	0.000	0.006	0.005	0.011	0.002	0.000	0.001	19	12	2	8
	Site # 2 (1)	0.5	0.034	1.8	1.7	0.1	0.000	0.002	0.002	0.003	0.004	0.001	0.001	15	9	1	1
	Site # 3 (2)	0.4	0.032	4.9	1.8	3.5	0.000	0.011	0.012	0.023	0.002	0.001	0.001	17	10	2	11
	Site # 4 (1)	0.0	0.037	1.9	1.7	0.2	0.000	0.001	0.002	0.002	0.002	0.001	0.001	11	7	1	0
Overall Median (Banff Area)		0.4	0.032	1.9	1.7	0.2	0.000	0.006	0.005	0.011	0.002	0.001	0.001	16	10	1	8
Canmore	Site # 5 (6)	0.1	0.024	1.8	1.7	0.1	0.001	0.005	0.004	0.008	0.002	0.001	0.000	50	27	2	1
	Site # 6 (7)	0.2	0.032	2.0	1.8	0.1	0.000	0.010	0.005	0.012	0.001	0.000	0.000	27	17	2	4
	Site # 7 (3)	0.3	0.026	1.8	1.7	0.1	0.000	0.011	0.006	0.016	0.000	0.000	0.000	16	9	2	4
	Site # 8 (2)	0.2	0.024	2.1	1.8	0.3	0.000	0.012	0.006	0.016	0.005	0.001	0.000	16	10	1	15
	Site # 9 (2)	0.0	0.023	1.9	1.8	0.1	0.000	0.003	0.006	0.009	0.001	0.000	0.000	14	9	1	2
	Site # 10 (4)	0.1	0.035	1.9	1.7	0.1	0.000	0.003	0.003	0.007	0.000	0.001	0.000	70	34	3	1
Overall Median (Canmore Area)		0.1	0.029	1.9	1.7	0.1	0.000	0.005	0.004	0.010	0.001	0.001	0.000	25	14	2	3
Cochrane	Site # 11 (5)	0.1	0.026	2.2	1.8	0.2	0.002	0.021	0.016	0.040	0.005	0.000	0.001	184	116	13	18
	Site # 12 (1)	0.5	0.002	1.9	1.5	0.2	0.003	0.034	0.024	0.058	0.009	0.001	0.001	643	383	34	25
	Site # 13 (1)	0.0	0.032	1.9	1.8	0.1	0.003	0.009	0.002	0.011	0.014	0.000	0.000	224	144	12	1
	Site # 14 (1)	0.2	0.028	2.1	2.1	0.1	0.001	0.004	0.004	0.007	0.000	0.001	0.000	67	33	3	12
	Site # 15 (1)	0.0	0.032	2.0	2.0	0.0	0.000	0.001	0.001	0.001	0.002	0.000	0.000	2082	1094	60	1
Overall Median (Cochrane Area)		0.1	0.028	2.0	1.8	0.2	0.002	0.011	0.015	0.025	0.005	0.000	0.000	224	144	13	16
Exshaw	Site # 16 (5)	0.1	0.050	2.2	2.0	0.2	0.000	0.008	0.009	0.016	0.025	0.001	0.000	275	163	16	12
	Site # 17 (4)	0.1	0.020	1.8	1.5	0.1	0.020	0.022	0.014	0.035	0.000	0.000	0.001	164	108	14	5
	Site # 18 (8)	0.1	0.018	1.9	1.8	0.1	0.006	0.026	0.013	0.042	0.000	0.001	0.000	81	52	7	3
	Site # 19 (2)	0.4	0.054	1.8	1.7	0.1	0.001	0.005	0.001	0.006	0.000	0.000	0.000	10	6	1	0
	Site # 20 (7)	0.2	0.031	2.0	1.8	0.1	0.032	0.047	0.020	0.069	0.010	0.003	0.001	190	120	13	7
	Site # 21 (3)	0.0	0.030	1.9	1.8	0.1	0.008	0.019	0.010	0.028	0.005	0.000	0.000	126	81	10	12
	Site # 22 (2)	0.1	0.039	1.8	1.7	0.1	0.000	0.001	0.001	0.002	0.000	0.000	0.000	17	10	1	0
Overall Median (Exshaw Area)		0.2	0.031	1.9	1.8	0.1	0.008	0.020	0.010	0.028	0.001	0.001	0.001	139	94	11	5
Overall Median		**0.2**	**0.030**	**1.9**	**1.8**	**0.1**	**0.001**	**0.010**	**0.007**	**0.016**	**0.001**	**0.001**	**0.000**	**74**	**40**	**4**	**4**

Table A.2 Maximum one-hour air quality parameter concentrations at each mobile monitoring site in the Bow Corridor (December 1999 to September 2000).

Area	Site (# of hours monitored)	CO ppm	O_3 ppm	THC ppm	CH_4 ppm	RHC ppm	SO_2 ppm	NO ppm	NO_2 ppm	NO_x ppm	NH_3 ppm	TRS ppm	H_2S ppm	TSP $\mu g/m^3$	PM_{10} $\mu g/m^3$	$PM_{2.5}$ $\mu g/m^3$	PAH ng/m^3
Banff	Site # 1 (2)	0.4	0.029	1.8	1.7	0.1	0.000	0.006	0.005	0.011	0.003	0.000	0.001	21	13	2	9
	Site # 2 (1)	0.5	0.034	1.8	1.7	0.1	0.000	0.002	0.002	0.003	0.004	0.001	0.001	15	9	1	1
	Site # 3 (2)	0.6	0.034	**7.8**	1.8	**6.6**	0.001	0.012	0.015	0.027	0.003	0.001	0.002	24	13	2	14
	Site # 4 (1)	0.0	0.037	1.9	1.7	0.2	0.000	0.001	0.002	0.002	0.002	0.001	0.001	11	7	1	0
Overall Maximum (Banff Area)		0.6	0.037	7.8	1.8	6.6	0.001	0.012	0.015	0.027	0.004	0.001	0.002	24	13	2	14
Canmore	Site # 5 (6)	0.3	0.051	2.0	2.0	0.2	0.002	0.015	0.006	0.020	0.007	0.002	0.001	95	44	4	5
	Site # 6 (7)	0.4	0.053	2.1	1.9	0.3	0.002	0.015	0.013	0.028	**0.034**	0.001	0.001	86	58	9	15
	Site # 7 (3)	0.3	0.036	2.0	1.7	0.3	0.000	0.021	0.007	0.029	0.000	0.001	0.001	44	28	2	4
	Site # 8 (2)	0.2	0.038	2.2	1.9	0.4	0.000	0.018	0.008	0.023	0.007	0.001	0.001	19	11	1	17
	Site # 9 (2)	0.0	0.027	2.0	1.8	0.2	0.000	0.004	0.007	0.010	0.001	0.001	0.000	20	14	2	3
	Site # 10 (4)	0.2	0.041	2.0	1.7	0.2	0.000	0.010	0.004	0.014	0.001	0.001	0.000	90	54	4	1
Overall Maximum (Canmore Area)		0.4	0.053	2.2	2.0	0.4	0.002	0.021	0.013	0.029	0.034	0.002	0.001	95	58	9	17
Cochrane	Site # 11 (5)	0.5	0.037	2.4	**2.2**	0.3	0.010	0.076	0.021	0.079	0.024	0.000	0.001	310	176	15	**36**
	Site # 12 (1)	0.5	0.002	1.9	1.5	0.2	0.003	0.034	0.024	0.058	0.009	0.001	0.001	643	383	34	25
	Site # 13 (1)	0.0	0.032	1.9	1.8	0.1	0.003	0.009	0.002	0.011	0.014	0.000	0.000	224	144	12	1
	Site # 14 (1)	0.2	0.028	2.1	2.1	0.1	0.001	0.004	0.004	0.007	0.000	0.001	0.000	67	33	3	12
	Site # 15 (1)	0.0	0.032	2.0	2.0	0.0	0.000	0.001	0.001	0.001	0.002	0.000	0.000	**2082**	**1094**	**60**	1
Overall Maximum (CochraneArea)		0.5	0.037	2.4	2.2	0.3	0.010	0.076	0.024	0.079	0.024	0.001	0.001	2082	1094	60	36
Exshaw	Site # 16 (5)	0.2	0.053	2.2	2.0	0.2	0.001	0.012	0.009	0.020	0.030	0.001	0.000	385	210	19	13
	Site # 17 (4)	0.5	0.043	1.9	2.0	0.2	0.036	0.073	0.023	0.095	0.001	0.001	**0.002**	427	201	15	7
	Site # 18 (8)	**1.1**	**0.056**	2.2	**2.2**	0.2	0.019	0.162	0.023	0.184	0.006	0.002	**0.002**	298	176	19	6
	Site # 19 (2)	0.6	0.054	1.9	1.7	0.1	0.001	0.006	0.001	0.007	0.000	0.000	0.001	11	6	1	0
	Site # 20 (7)	0.3	0.045	2.1	2.0	0.1	**0.092**	**0.296**	**0.031**	**0.295**	0.027	**0.004**	**0.002**	217	149	19	13
	Site # 21 (3)	0.1	0.032	2.0	1.8	0.1	0.020	0.077	0.023	0.099	0.006	0.001	0.001	139	94	12	14
	Site # 22 (2)	0.1	0.039	1.8	1.7	0.1	0.000	0.002	0.002	0.003	0.000	0.001	0.000	20	12	1	0
Overall Maximum (Exshaw Area)		1.1	0.056	2.2	2.2	0.2	0.092	0.296	0.031	0.295	0.030	0.004	0.002	427	210	19	14
Overall Maximum		**1.1**	**0.056**	**7.8**	**2.2**	**6.6**	**0.092**	**0.296**	**0.031**	**0.295**	**0.034**	**0.004**	**0.002**	**2082**	**1094**	**60**	**36**
One-Hour Guideline		**13.0**	**0.082**	**n/a**	**n/a**	**n/a**	**0.172**	**n/a**	**0.212**	**n/a**	**2.0**	**n/a**	**0.010**	**n/a**	**n/a**	**n/a**	**n/a**

bold text - indicates maximum one-hour concentration measured during the survey

n/a - indicates that there is no one-hour guideline for this parameter

Table A.3 Median one-hour air quality parameter concentrations in Alberta*.

Air Quality Station	Station or Survey Type	Monitoring Period	CO (ppm)	O_3 (ppm)	THC (ppm)	CH_4 (ppm)	RHC (ppm)	SO_2 (ppm)	NO_2 (ppm)	NH_3 (ppm)	TRS (ppm)	H_2S (ppm)	TSP $\mu g/m^3$	PM_{10} $\mu g/m^3$	$PM_{2.5}$ $\mu g/m^3$	PAHs ng/m^3
Bow Corridor[1]	mobile survey	Dec. 1999 to Sep. 2000	0.2	0.030	1.9	1.8	0.1	0.001	0.007	0.001	0.001	0.000	74	40	4	4
County of Grande Prairie[1]	mobile survey	Dec. 1998 to Oct. 1999	0.2	0.036	2.0	1.7	0.2	0.001	0.002	0.001	0.000	0.000	14	9	2	2
Caroline/Sundre area[1]	mobile survey	Apr. 1997 to Apr. 1998	0.3	0.042	2.1	1.8	0.2	0.002	0.009	n/a	0.000	0.000	4	3	1	n/a
City of Lethbridge[1]	mobile survey	Sep. 1998 to Jul. 1999	0.2	0.046	1.9	1.6	0.2	0.000	0.003	0.005	0.000	0.001	17	11	2	3
City of Medicine Hat[1]	mobile survey	May 1998 to Jan. 1999	0.4	0.031	2.1	1.8	0.2	0.001	0.009	0.003	0.000	0.000	16	11	2	5
Lethbridge area (Picture Butte, Sterling)[1]	mobile survey	Sep. 1998 to Jul. 1999	0.2	0.044	2.1	1.8	0.2	0.001	0.002	0.075	0.002	0.001	42	24	3	2
Beaverlodge[2]	rural	Jan. to Dec. 2000	n/a	0.027	n/a	n/a	n/a	0.000	0.002	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Calgary Central[2]	urban	Jan. to Dec. 2000	0.6	0.012	2.0	n/a	n/a	n/a	0.027	n/a	n/a	n/a	n/a	18	9	n/a
Calgary East[2]	urban	Jan. to Dec. 2000	0.5	0.013	2.2	n/a	n/a	0.002	0.023	n/a	n/a	0.001	n/a	n/a	n/a	n/a
Calgary Northwest[2]	urban	Jan. to Dec. 2000	0.3	0.020	2.1	n/a	n/a	n/a	0.014	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Edmonton Central[2]	urban	Jan. to Dec. 2000	0.6	0.013	1.9	n/a	n/a	n/a	0.023	n/a	n/a	n/a	n/a	n/a	9	n/a
Edmonton East[2]	urban	Jan. to Dec. 2000	0.3	0.019	2.3	n/a	n/a	0.002	0.015	n/a	n/a	0.000	n/a	15	8	n/a
Edmonton Northwest[2]	urban	Jan. to Dec. 2000	0.4	0.015	2.2	n/a	n/a	n/a	0.018	n/a	n/a	n/a	n/a	17	9	n/a
Fort Saskatchewan[2]	small urban	Jan. to Dec. 2000	0.3	0.020	1.9	n/a	n/a	0.001	0.009	0.003	n/a	0.000	n/a	n/a	n/a	n/a
Red Deer	small urban	Jan. to Dec. 2000	0.2	0.018	2.2	n/a	n/a	0.000	0.010	n/a	n/a	0.000	n/a	14	n/a	n/a
Buffalo Viewpoint[3]	industrial	Jan. to Dec. 2000	n/a	n/a	1.9	n/a	n/a	0.000	n/a	n/a	n/a	0.000	n/a	n/a	n/a	n/a
Fort Chipewyan[3]	rural	Jan. to Dec. 2000	n/a	0.027	n/a	n/a	n/a	0.000	0.000	n/a	n/a	n/a	n/a	n/a	3	n/a
Fort McKay[3]	rural	Jan. to Dec. 2000	n/a	0.019	1.8	n/a	n/a	0.000	0.004	n/a	0.000	n/a	n/a	n/a	5	n/a
Fort McMurray (Athabasca Valley)[3]	small urban	Jan. to Dec. 2000	0.2	0.015	1.9	n/a	n/a	0.000	0.007	n/a	0.000	n/a	n/a	n/a	5	n/a
Fort McMurray (Patricia McInnes)[3]	small urban	Jan. to Dec. 2000	n/a	0.022	1.9	n/a	n/a	0.000	0.003	n/a	0.000	n/a	n/a	n/a	5	n/a
Lower Camp[3]	industrial	Jan. to Dec. 2000	n/a	n/a	1.9	n/a	n/a	0.001	n/a	n/a	n/a	0.001	n/a	n/a	n/a	n/a
Mannix[3]	industrial	Jan. to Dec. 2000	n/a	n/a	1.9	n/a	n/a	0.001	n/a	n/a	n/a	0.000	n/a	n/a	n/a	n/a
Mildred Lake[3]	industrial	Jan. to Dec. 2000	n/a	n/a	2.0	n/a	n/a	0.001	n/a	n/a	n/a	0.000	n/a	n/a	n/a	n/a
Carrot Creek[4]	rural	Jan. to Dec. 2000	n/a	0.027	n/a	n/a	n/a	0.001	0.004	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hightower Ridge[4]	background	Jan. to Dec. 2000	n/a	0.045	n/a	n/a	n/a	0.000	0.000	n/a	n/a	n/a	n/a	5	3	n/a
Steeper[4]	rural	Jan. to Dec. 2000	n/a	0.040	n/a	n/a	n/a	0.000	0.001	n/a	n/a	n/a	n/a	6	n/a	n/a
Tomahawk[4]	rural	Jan. to Dec. 2000	n/a	0.029	n/a	n/a	n/a	0.001	0.003	n/a	n/a	n/a	n/a	8	4	n/a
Violet Grove[4]	rural	Jan. to Dec. 2000	n/a	0.034	2.1	2.1	0.2	0.000	0.002	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sherwood Park[5]	small urban	Jan. to Dec. 2000	n/a	n/a	2.0	n/a	n/a	0.001	n/a	n/a	n/a	0.000	n/a	n/a	n/a	n/a
Caroline[6]	rural	Aug. to Dec. 2000	n/a	0.026	2.2	2.0	n/a	0.001	0.003	n/a	0.000	0.000	n/a	n/a	n/a	n/a

1 Mobile survey conducted by Alberta Environment.
2 Station operated by Alberta Environment.
3 Station operated by the Wood Buffalo Environmental Association
4 Station operated by the West Central Airshed Society.
5 Station operated by the Strathcona Industrial Association.
6 Station operated by the Parkland Airshed Management Association.
n/a Parameter not monitored or data not available.

* Data is from the Alberta Ambient Air Data Management System (http://www.casadata.org).

Table A 4 Maximum one-hour air quality parameter concentrations in Alberta*.

Air Quality Station	Station or Survey Type	Monitoring Period	CO (ppm)	O_3 (ppm)	THC (ppm)	CH_4 (ppm)	RHC (ppm)	SO_2 (ppm)	NO_2 (ppm)	NH_3 (ppm)	TRS (ppm)	H_2S (ppm)	TSP $\mu g/m^3$	PM_{10} $\mu g/m^3$	$PM_{2.5}$ $\mu g/m^3$	PAHs ng/m^3
Bow Corridor[1]	mobile survey	Dec. 1999 to Sep. 2000	1.1	0.056	7.8	2.2	6.6	0.092	0.031	0.034	0.004	0.002	2082	1094	60	36
County of Grande Prairie[1]	mobile survey	Dec. 1998 to Oct. 1999	1.0	0.064	32.4	6.4	29.4	0.043	0.061	0.030	0.010	0.009	2305	1287	101	35
Caroline/Sundre area[1]	mobile survey	Apr. 1997 to Apr. 1998	0.9	0.059	2.9	2.6	0.7	0.043	0.040	n/a	0.008	0.008	52	43	17	n/a
City of Lethbridge[1]	mobile survey	Sep. 1998 to Jul. 1999	2.4	0.062	2.2	1.9	0.4	0.007	0.016	0.020	0.001	0.003	405	363	294	21
City of Medicine Hat[1]	mobile survey	May 1998 to Jan. 1999	2.8	0.062	2.6	2.3	0.4	0.029	0.080	0.027	0.001	0.004	213	135	12	35
Lethbridge area (Picture Butte, Sterling)[1]	mobile survey	Sep. 1998 to Jul. 1999	1.2	0.059	9.5	7.1**	1.6	0.004	0.013	1.364	0.054	0.054	490	298	32	11
Beaverlodge[2]	rural	Jan. to Dec. 2000	n/a	0.064	n/a	n/a	n/a	0.038	0.029	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Calgary Central[2]	urban	Jan. to Dec. 2000	6.1	0.058	4.3	n/a	n/a	n/a	0.100	n/a	n/a	n/a	n/a	291	112	n/a
Calgary East[2]	urban	Jan. to Dec. 2000	6.2	0.064	5.0	n/a	n/a	0.072	0.101	n/a	n/a	0.022	n/a	n/a	n/a	n/a
Calgary Northwest[2]	urban	Jan. to Dec. 2000	6.5	0.067	4.8	n/a	n/a	n/a	0.089	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Edmonton Central[2]	urban	Jan. to Dec. 2000	11.3	0.064	4.8	n/a	n/a	n/a	0.083	n/a	n/a	n/a	n/a	n/a	40	n/a
Edmonton East[2]	urban	Jan. to Dec. 2000	2.7	0.072	24.2	n/a	n/a	0.057	0.082	n/a	n/a	0.029	n/a	395	60	n/a
Edmonton Northwest[2]	urban	Jan. to Dec. 2000	7.7	0.066	7.1	n/a	n/a	n/a	0.094	n/a	n/a	n/a	n/a	294	231	n/a
Fort Saskatchewan[2]	small urban	Jan. to Dec. 2000	4.6	0.075	4.3	n/a	n/a	0.025	0.081	0.154	n/a	0.006	n/a	n/a	n/a	n/a
Red Deer	small urban	Jan. to Dec. 2000	3.6	0.065	11.4	n/a	n/a	0.017	0.060	n/a	n/a	0.013	n/a	382	n/a	n/a
Buffalo Viewpoint[3]	industrial	Jan. to Dec. 2000	n/a	n/a	9.5	n/a	n/a	0.184	n/a	n/a	n/a	0.021	n/a	n/a	n/a	n/a
Fort Chipewyan[3]	rural	Jan. to Dec. 2000	n/a	0.051	n/a	n/a	n/a	0.013	0.028	n/a	n/a	n/a	n/a	n/a	16	n/a
Fort McKay[3]	rural	Jan. to Dec. 2000	n/a	0.060	3.5	n/a	n/a	0.123	0.036	n/a	0.051	n/a	n/a	n/a	48	n/a
Fort McMurray (Athabasca Valley)[3]	small urban	Jan. to Dec. 2000	4.4	0.065	4.2	n/a	n/a	0.033	0.052	n/a	0.006	n/a	n/a	n/a	121	n/a
Fort McMurray (Patricia McInnes)[3]	small urban	Jan. to Dec. 2000	n/a	0.058	4.0	n/a	n/a	0.052	0.037	n/a	0.007	n/a	n/a	n/a	149	n/a
Lower Camp[3]	industrial	Jan. to Dec. 2000	n/a	n/a	6.1	n/a	n/a	0.107	n/a	n/a	n/a	0.088	n/a	n/a	n/a	n/a
Mannix[3]	industrial	Jan. to Dec. 2000	n/a	n/a	5.9	n/a	n/a	0.284	n/a	n/a	n/a	0.020	n/a	n/a	n/a	n/a
Mildred Lake[3]	industrial	Jan. to Dec. 2000	n/a	n/a	15.1	n/a	n/a	0.225	n/a	n/a	n/a	0.099	n/a	n/a	n/a	n/a
Carrot Creek[4]	rural	Jan. to Dec. 2000	n/a	0.078	n/a	n/a	n/a	0.023	0.046	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hightower Ridge[4]	background	Jan. to Dec. 2000	n/a	0.081	n/a	n/a	n/a	0.009	0.015	n/a	n/a	n/a	n/a	41	19	n/a
Steeper[4]	rural	Jan. to Dec. 2000	n/a	0.080	n/a	n/a	n/a	0.006	0.023	n/a	n/a	n/a	n/a	198	n/a	n/a
Tomahawk[4]	rural	Jan. to Dec. 2000	n/a	0.075	n/a	n/a	n/a	0.034	0.037	n/a	n/a	n/a	n/a	197	37	n/a
Violet Grove[4]	rural	Jan. to Dec. 2000	n/a	0.075	19.4	2.9	4.9	0.018	0.034	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sherwood Park[5]	small urban	Jan. to Dec. 2000	n/a	n/a	4.9	n/a	n/a	0.053	n/a	n/a	n/a	0.005	n/a	n/a	n/a	n/a
Caroline[6]	rural	Jan. to Dec. 2000	n/a	0.065	7.8	4.1	n/a	0.070	0.031	n/a	0.019	0.016	n/a	n/a	n/a	n/a

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n/a Parameter not monitored or data not available.
* Data is from the Alberta Ambient Air Data Management System (http://www.casadata.org).

Table A.5 One-hour average air quality parameter concentrations in the Banff, Canmore and Cochrane areas.

Area	Monitoring Location	Site #	Date	Monitoring Time (MST)	CO ppm	O_3 ppm	THC ppm	CH_4 ppm	RHC ppm	SO_2 ppm	NO ppm	NO_2 ppm	NO_X ppm	NH_3 ppm	TRS ppm	H_2S ppm	TSP µg/m³	PM_{10} µg/m³	$PM_{2.5}$ µg/m³	PAH ng/m³
Banff	High School (Elk St & Beaver St)	Site # 1	06-Aug-00	10:41 a.m. to 11:41 a.m.	0.4	0.027	1.8	1.7	0.1	0.000	0.006	0.004	0.011	0.003	0.000	0.001	18	11	1	9
				11:42 a.m. to 12:40 p.m.	0.4	0.029	1.8	1.7	0.1	0.000	0.005	0.005	0.011	0.002	0.000	0.001	21	13	2	7
	Canada Place (Banff Ave & Spray Ave)	Site # 2		12:48 p.m. to 1:48 p.m.	0.5	0.034	1.8	1.7	0.1	0.000	0.002	0.002	0.003	0.004	0.001	0.001	15	9	1	1
	Fire Hall (Caribou St & Beaver St)	Site # 3		2:05 p.m. to 3:18 p.m.	0.6	0.030	2.0	1.7	0.4	0.000	0.009	0.010	0.018	0.003	0.001	0.001	24	13	2	14
				5:18 p.m. to 6:36 p.m.	0.3	0.034	7.8	1.8	6.6	0.001	0.012	0.015	0.027	0.002	0.001	0.002	10	6	2	8
	Recreation grounds (end of Birch Ave)	Site # 4		4:12 p.m. to 5:12 p.m.	0.0	0.037	1.9	1.7	0.2	0.000	0.001	0.002	0.002	0.002	0.001	0.001	11	7	1	0
Canmore	Canmore Wastewater Sewage Treatment Plant and Composting Operation	Site # 5	15-Dec-99	3:03 p.m. to 4:03 p.m.	0.0	0.024	1.7	1.4	0.2	0.001	0.004	0.006	0.009	0.000	0.001	0.000	95	44	2	1
				4:03 p.m. to 5:01 p.m.	0.1	0.024	1.7	1.4	0.2	0.001	0.007	0.006	0.012	0.003	0.001	0.000	5	3	0	5
			21-Mar-00	11:11a.m. to 12:11 p.m.	0.1	0.051	1.7	1.6	0.1	0.002	0.005	0.002	0.006	0.000	0.002	0.001	87	40	4	0
			11-Jul-00	8:37 a.m. to 9:42 a.m.	0.0	0.032	1.9	1.8	0.1	0.002	0.005	0.001	0.005	0.007	0.001	0.000	28	14	1	0
			26-Sep-00	12:20 p.m. to 1:19 p.m.	0.2	0.025	2.0	2.0	0.0	0.001	0.004	0.002	0.004	0.007	0.002	0.000	73	39	3	0
			27-Sep-00	8:46 a.m. to 9:45 a.m.	0.3	0.009	1.9	1.9	0.1	0.000	0.015	0.006	0.020	0.000	0.000	0.000	22	12	2	3
	2^{nd} Ave & 15^{th} St	Site # 6	21-Mar-00	10:20 a.m. to 11:10 a.m.	0.2	0.045	1.7	1.6	0.1	0.001	0.010	0.003	0.011	0.001	0.000	0.000	86	58	9	3
	2^{nd} Ave & 13^{th} St		11-Jul-00	9:50 a.m. to 10:51 a.m.	0.2	0.030	2.0	1.8	0.1	0.002	0.012	0.007	0.017	0.007	0.001	0.000	45	27	3	11
			12-Jul-00	4:16 p.m. to 5:16 p.m.	0.2	0.053	2.1	1.9	0.2	0.000	0.005	0.008	0.012	0.034	0.000	0.000	38	23	3	4
	2^{nd} Ave & 17^{th} St		05-Aug-00	5:00 p.m. to 6:01 p.m.	0.0	0.032	2.0	1.8	0.1	0.000	0.003	0.004	0.005	0.003	0.000	0.000	12	8	1	5
			07-Aug-00	12:20 p.m. to 1:20 p.m.	0.2	0.038	1.9	1.7	0.1	0.000	0.005	0.004	0.009	0.000	0.001	0.001	14	8	1	3
				6:11 p.m. to 7:38 p.m.	0.4	0.024	2.1	1.8	0.3	0.000	0.015	0.013	0.028	0.001	0.001	0.000	17	11	2	15
	2^{nd} Ave & 14^{th} St		27-Sep-00	9:55 a.m. to 10:54 a.m.	0.1	0.013	1.9	1.9	0.0	0.000	0.015	0.005	0.019	0.001	0.000	0.000	27	17	2	3
	Main St & Railway Ave (Provincial Building parking lot)	Site # 7	06-Aug-00	7:37 a.m. to 8:39 a.m.	0.1	0.008	1.8	1.7	0.0	0.000	0.021	0.007	0.029	0.000	0.000	0.000	12	8	2	3
			07-Aug-00	9:53 a.m. to 10:54 a.m.	0.3	0.026	1.8	1.7	0.1	0.000	0.011	0.006	0.016	0.000	0.001	0.000	16	9	1	4
				3:52 p.m. to 4:52 p.m.	0.3	0.036	2.0	1.7	0.3	0.000	0.004	0.006	0.011	0.000	0.000	0.001	44	28	2	4
	Elk Run Blvd & Hwy 1A	Site # 8	07-Aug-00	7:40 a.m. to 8:43 a.m.	0.2	0.010	2.2	1.9	0.4	0.000	0.018	0.008	0.023	0.007	0.001	0.000	19	11	1	17
				1:26 p.m. to 2:25 p.m.	0.1	0.038	1.9	1.7	0.1	0.000	0.006	0.004	0.009	0.003	0.001	0.001	13	8	1	13
	Parking area off Benchlands Tr	Site # 9	05-Aug-00	6:24 p.m. to 7:33 p.m.	0.0	0.027	2.0	1.8	0.2	0.000	0.003	0.007	0.010	0.001	0.000	0.000	20	14	2	3
			07-Aug-00	8:48 a.m. to 9:47 a.m.	0.0	0.019	1.7	1.7	0.0	0.000	0.004	0.004	0.008	0.000	0.001	0.000	7	4	1	1
	Rundle Dr & 3 Sisters Dr (old town hall)	Site # 10	06-Aug-00	8:47 a.m. to 9:49 a.m.	0.2	0.018	1.8	1.6	0.1	0.000	0.010	0.003	0.014	0.001	0.000	0.000	86	42	3	1
			07-Aug-00	11:09 a.m. to 12:09 p.m.	0.1	0.037	1.8	1.7	0.1	0.000	0.003	0.004	0.007	0.000	0.001	0.000	54	27	2	1
				2:49 p.m. to 3:48 p.m.	0.0	0.041	1.9	1.7	0.1	0.000	0.001	0.001	0.002	0.000	0.000	0.000	9	5	1	0
				4:59 p.m. to 5:59 p.m.	0.1	0.034	2.0	1.7	0.2	0.000	0.003	0.003	0.007	0.000	0.001	0.000	90	54	4	1
Cochrane	Spray Lake Sawmill (E side on River Ave)	Site #11	16-Dec-99	9:48 a.m. to 10:47 a.m.	0.2	0.011	1.9	1.5	0.3	0.004	0.032	0.021	0.052	0.005	0.000	0.001	267	150	13	35
			21-Mar-00	6:16 p.m. to 7:18 p.m.	0.1	0.037	2.2	1.8	0.2	0.002	0.011	0.015	0.025	0.000	0.000	0.000	76	39	5	18
			23-Mar-00	9:58 a.m. to 11:06 a.m.	0.5	0.026	2.4	1.8	0.2	0.002	0.021	0.020	0.040	0.016	0.000	0.001	59	32	5	16
			12-Jul-00	7:53 a.m. to 8:55 a.m.	0.1	0.008	1.9	1.8	0.1	0.010	0.076	0.016	0.079	0.024	0.000	0.001	184	116	15	36
			27-Sep-00	3:51 p.m. to 4:50 p.m.	0.0	0.028	2.2	2.2	0.2	0.000	0.006	0.005	0.011	0.000	0.000	0.000	310	176	15	3
	Burnco Rock Products (W side on River Ave)	Site #12	17-Dec-99	10:22 a.m. to 11:21 a.m.	0.5	0.002	1.9	1.5	0.2	0.003	0.034	0.024	0.058	0.009	0.001	0.001	643	383	34	25
one-hour guideline					**13.0**	**0.082**	**n/a**	**n/a**	**n/a**	**0.172**	**n/a**	**0.212**	**n/a**	**2.0**	**n/a**	**0.010**	**n/a**	**n/a**	**n/a**	**n/a**

n/a No one hour guideline.

List of Air Quality Parameters

CO - carbon monoxide
O_3 - ozone
THC - total hydrocarbons
CH_4 - methane
RHC - reactive hydrocarbons
SO_2 - sulphur dioxide
NO - nitric oxide
NO_2 - nitrogen dioxide
NO_X - total oxides of nitrogen
NH_3 - ammonia
TRS - total reduced sulphur
H_2S - hydrogen sulphide
TSP - total suspended particulates
PM10 - inhalable particulates
PM2.5 - respirable particulates
PAH - polycyclic aromatic hydrocarbons

Table A.6 One-hour average air quality parameter concentrations in the Banff, Canmore and Cochrane areas.

Area	Monitoring Location	Site #	Date	Monitoring Time (MST)	CO ppm	O_3 ppm	THC ppm	CH_4 ppm	RHC ppm	SO_2 ppm	NO ppm	NO_2 ppm	NO_X ppm	NH_3 ppm	TRS ppm	H_2S ppm	TSP µg/m³	PM_{10} µg/m³	$PM_{2.5}$ µg/m³	PAH ng/m³
Cochrane	Shell Jumping Pound Gas Plant (Rge Rd 51 & Twp Rd 252)	Site #13	12-Jul-00	9:47 a.m. to 10:51 a.m.	0.0	0.032	1.9	1.8	0.1	0.003	0.009	0.002	0.011	0.014	0.000	0.000	224	144	12	1
	Domtar excavation (1 Block S of Railway St on 2nd Ave)	Site #14	26-Sep-00	2:42 p.m. to 3:41 p.m.	0.2	0.028	2.1	2.1	0.1	0.001	0.004	0.004	0.007	0.000	0.001	0.000	67	33	3	12
	Shell Jumping Pound Gas Plant (Rge Rd 50 & Twp Rd 252)	Site #15	27-Sep-00	2:32 p.m. to 3:31 p.m.	0.0	0.032	2.0	2.0	0.0	0.000	0.001	0.001	0.001	0.002	0.000	0.000	2082	1094	60	1
Exshaw	Municipal District of Bighorn #8 building	Site #16	15-Dec-99	11:27 a.m. to 12:28 p.m.	0.0	0.021	1.7	1.4	0.2	0.001	0.009	0.009	0.018	0.001	0.001	0.000	385	210	19	8
			12-Jul-00	12:00 p.m. to 1:00 p.m.	0.1	0.045	2.2	2.0	0.2	0.001	0.012	0.009	0.020	0.025	0.000	0.000	139	93	11	9
				1:00 p.m. to 2:00 p.m.	0.1	0.050	2.2	2.0	0.2	0.000	0.008	0.009	0.016	0.024	0.000	0.000	170	109	12	12
				2:01 p.m. to 3:00 p.m.	0.2	0.053	2.2	2.0	0.2	0.000	0.006	0.007	0.013	0.025	0.001	0.000	275	163	16	13
				3:01 p.m. to 3:49 p.m.	0.2	0.052	2.2	2.0	0.2	0.000	0.006	0.009	0.014	0.030	0.001	0.000	289	167	17	13
	Mt. McGillivery Dr & Heart Mtn Dr on N side of Hwy 1A	Site #17	15-Dec-99	1:05 p.m. to 2:11 p.m.	0.0	0.007	1.7	1.4	0.2	0.036	0.073	0.023	0.095	0.000	0.001	0.002	427	201	15	7
			16-Dec-99	1:39 p.m. to 2:48 p.m.	0.5	0.021	1.7	1.4	0.2	0.017	0.023	0.016	0.038	0.001	0.000	0.001	198	126	14	6
			21-Mar-00	3:13 p.m. to 4:09 p.m.	0.2	0.043	1.9	1.7	0.1	0.023	0.021	0.012	0.031	0.000	0.000	0.001	130	91	14	3
			27-Sep-00	11:17 a.m. to 12:16 p.m.	0.0	0.018	1.9	2.0	0.0	0.010	0.020	0.006	0.026	0.000	0.000	0.000	107	70	10	4
	2.5 km E of Exshaw @ Kananaskis Village	Site #18	16-Dec-99	3:10 p.m. to 4:09 p.m.	0.7	0.017	2.0	1.6	0.2	0.009	0.024	0.020	0.045	0.000	0.001	0.001	298	176	19	6
			21-Mar-00	4:23 p.m. to 5:23 p.m.	0.1	0.056	1.8	1.7	0.1	0.002	0.003	0.002	0.004	0.000	0.000	0.000	46	29	4	2
			22-Mar-00	2:52 p.m. to 3:52 p.m.	0.1	0.043	2.0	1.8	0.1	0.003	0.002	0.003	0.008	0.000	0.000	0.000	31	20	3	1
			11-Jul-00	1:50 p.m. to 2:51 p.m.	0.0	0.025	2.0	1.9	0.1	0.006	0.029	0.015	0.044	0.006	0.001	0.001	232	142	15	4
	Access Rd to Continental Lime		08-Aug-00	8:31 a.m. to 9:34 a.m.	0.0	0.014	1.7	1.7	0.0	0.005	0.028	0.013	0.041	0.001	0.000	0.000	94	60	6	5
	2.5 km E of Exshaw @ Kananaskis Village		08-Aug-00	7:25 a.m. to 8:27 a.m.	0.0	0.002	1.8	1.8	0.1	0.019	0.162	0.023	0.184	0.005	0.001	0.002	68	45	8	3
			26-Sep-00	8:38 a.m. to 9:37 a.m.	1.1	0.018	1.8	1.9	0.0	0.000	0.000	0.000	0.001	0.000	0.001	0.000	7	5	1	0
			27-Sep-00	12:23 p.m. to 1:22 p.m.	0.4	0.012	2.2	2.2	0.1	0.011	0.040	0.013	0.053	0.002	0.002	0.001	210	127	14	2
	Lac Des Arc	Site #19	21-Mar-00	12:53 p.m. to 1:53 p.m.	0.3	0.053	1.8	1.6	0.1	0.001	0.005	0.001	0.006	0.000	0.000	0.000	10	6	1	0
				1:54 p.m. to 2:54 p.m.	0.6	0.054	1.9	1.7	0.1	0.001	0.006	0.001	0.007	0.000	0.000	0.001	11	6	1	0
	T-Intersection S side of Hwy 1A across railway tracks	Site #20	22-Mar-00	9:54 a.m. to 10:53 a.m.	0.2	0.035	2.1	1.8	0.1	0.015	0.025	0.013	0.040	0.014	0.002	0.001	161	100	11	9
				10:54 a.m. to 11:54 a.m.	0.2	0.036	2.0	1.8	0.1	0.025	0.031	0.017	0.051	0.001	0.003	0.001	185	120	13	4
				11:54 a.m. to 12:55 p.m.	0.2	0.031	2.0	1.8	0.1	0.032	0.047	0.020	0.069	0.008	0.003	0.002	217	149	19	2
				12:56 p.m. to 1:56 p.m.	0.2	0.024	2.1	1.8	0.1	0.041	0.061	0.022	0.085	0.021	0.004	0.002	190	133	17	7
				1:57 p.m. to 2:47 p.m.	0.2	0.045	2.1	1.8	0.1	0.009	0.011	0.006	0.020	0.003	0.003	0.001	80	56	8	4
			26-Sep-00	9:51 a.m. to 10:50 a.m.	0.2	0.003	1.9	1.9	0.0	0.092	0.296	0.031	0.295	0.027	0.003	0.002	212	133	18	13
				10:51 a.m. to 11:50 a.m.	0.3	0.009	1.9	2.0	0.0	0.049	0.111	0.022	0.130	0.010	0.002	0.001	197	114	11	9
	Community Hall @ Heart Mtn Dr & Barrier Mtn Dr.	Site #21	11-Jul-00	11:34 a.m. to 12:34 p.m.	0.0	0.030	1.9	1.8	0.1	0.008	0.019	0.010	0.028	0.005	0.000	0.000	139	94	12	6
				12:35 p.m. to 1:34 p.m.	0.0	0.032	2.0	1.8	0.1	0.003	0.013	0.010	0.022	0.006	0.000	0.000	126	81	10	12
			08-Aug-00	10:45 a.m. to 11:46 a.m.	0.1	0.017	1.8	1.7	0.1	0.020	0.077	0.023	0.099	0.000	0.001	0.001	108	68	8	14
	Grotto Mountain Picnic area	Site #22	08-Aug-00	12:12 p.m. to 1:12 p.m.	0.1	0.039	1.8	1.7	0.1	0.000	0.002	0.002	0.003	0.000	0.000	0.000	20	12	1	0
				1:12 p.m. to 2:13 p.m.	0.0	0.039	1.8	1.7	0.1	0.000	0.001	0.001	0.001	0.000	0.001	0.000	14	8	1	0
one-hour guideline					**13.0**	**0.082**	**n/a**	**n/a**	**n/a**	**0.172**	**n/a**	**0.212**	**n/a**	**2.0**	**n/a**	**0.010**	**n/a**	**n/a**	**n/a**	**n/a**

n/a No one hour guideline.

List of Air Quality Parameters

- CO - carbon monoxide
- O_3 - ozone
- THC - total hydrocarbons
- CH_4 - methane
- RHC - reactive hydrocarbons
- SO_2 - sulphur dioxide
- NO - nitric oxide
- NO_2 - nitrogen dioxide
- NO_X - total oxides of nitrogen
- NH_3 - ammonia
- TRS - total reduced sulphur
- H_2S - hydrogen sulphide
- TSP - total suspended particulates
- PM_{10} - inhalable particulates
- $PM_{2.5}$ - respirable particulates
- PAH - polycyclic aromatic hydrocarbons

Table A.7 Weather conditions and MAML operator's comments at monitoring sites in Banff and Canmore.

Area	Monitoring Location	Site #	Date	Monitoring Time (MST)	Temp. (°C)	RH (%)	Wind Spd. (km/h)	Wind Dir.	Cloud Cover	Comments from MAML Operator
Banff	High School (Elk St & Beaver St)	Site # 1	06-Aug-00	10:41 a.m. to 11:41 a.m.	27	33	7	SW	60%	No Comments from the MAML operator.
				11:42 a.m. to 12:40 p.m.	26	32	9	W	n/a	
	Canada Place (Banff Ave & Spray Ave)	Site # 2		12:48 p.m. to 1:48 p.m.	28	24	6	SW	n/a	
	Fire Hall (Caribou St & Beaver St)	Site # 3		2:05 p.m. to 3:18 p.m.	29	22	7	SW	40%	
				5:18 p.m. to 6:36 p.m.	16	69	5	S	n/a	High levels of RHC due to vapours from Bulk fuel truck unloading at Esso across the alley, ~25m in front of the MAML. Highest level for one 5 sec avg was 544 ppm. Raining.
	Recreation grounds (end of Birch Ave)	Site # 4		4:12 p.m. to 5:12 p.m.	18	59	9	W	80%	Raining
Canmore	Canmore Wastewater Sewage Treatment Plant and Composting Operation	Site # 5	15-Dec-99	3:03 p.m. to 4:03 p.m.	-1	75	12	S	n/a	Downwind of composting operation.
				4:03 p.m. to 5:01 p.m.	1	72	14	SW	n/a	Check for odours. None detected.
			21-Mar-00	11:11a.m. to 12:11 p.m.	8	26	15	W	10%	Odour from composting operation ~120m NW of treatment plant. No covering on any of the piles of manure, etc, - the wind is blowing it all over.
			11-Jul-00	8:37 a.m. to 9:42 a.m.	22	34	9	V	60%	200m downwind of the composting operation, MAML just N of the Canmore Wastewater treatment plant. No odours.
			26-Sep-00	12:20 p.m. to 1:19 p.m.	21	26	6	NW	Sunny	Downwind of composting operation. Beside the Canmore wastewater treatment plant. No odours.
			27-Sep-00	8:46 a.m. to 9:45 a.m.	8	62	4	V	Sunny	Wastewater Treatment plant, downwind of composting operation. No odours.
	2nd Ave & 15th St	Site # 6	21-Mar-00	10:20a.m. to 11:10 a.m.	7	32	20	SE	n/a	No Comments from the MAML operator.
	2nd Ave & 13th St		11-Jul-00	9:50 a.m. to 10:51 a.m.	21	32	7	NW	80%	No rain.
			12-Jul-00	4:16 p.m. to 5:16 p.m.	29	17	7	W	n/a	No Comments from the MAML operator.
	2nd Ave & 17th St		05-Aug-00	5:00 p.m. to 6:01 p.m.	26	27	14	W	20%	
			07-Aug-00	12:20 p.m. to 1:20 p.m.	23	29	8	W	60%	
				6:11 p.m. to 7:38 p.m.	22	37	6	NW	40%	
	2nd Ave & 14th St		27-Sep-00	9:55 a.m. to 10:54 a.m.	15	41	9	NW	Sunny	
	Main St & Railway Ave (Provincial Building parking lot)	Site # 7	06-Aug-00	7:37 a.m. to 8:39 a.m.	17	57	5	E	Clear	
			07-Aug-00	9:53 a.m. to 10:54 a.m.	20	51	6	W	60%	
				3:52 p.m. to 4:52 p.m.	25	27	6	V	60%	
	Elk Run Blvd & Hwy 1A	Site # 8	07-Aug-00	7:40 a.m. to 8:43 a.m.	12	80	7	V	40%	
				1:26 p.m. to 2:25 p.m.	24	28	10	W	60%	
	Parking area off Benchlands Tr	Site # 9	05-Aug-00	6:24 p.m. to 7:33 p.m.	25	30	5	W	20%	
			07-Aug-00	8:48 a.m. to 9:47 a.m.	16	66	8	N	40%	
	Rundle Dr & 3 Sisters Dr (old town hall)	Site #10	06-Aug-00	8:47 a.m. to 9:49 a.m.	23	41	4	SE	Clear	
			07-Aug-00	11:09 a.m. to 12:09 p.m.	23	36	3	E	40%	
				2:49 p.m. to 3:48 p.m.	24	28	13	W	n/a	
				4:59 p.m. to 5:59 p.m.	23	33	3	V	40%	

Table A.8 Weather conditions and MAML operator's comments at monitoring sites in Cochrane and Exshaw.

Area	Monitoring Location	Site #	Date	Monitoring Time (MST)	Temp. (°C)	RH (%)	Wind Spd. (km/h)	Wind Dir.	Cloud Cover	Comments from MAML Operator
Cochrane	Spray Lake Sawmill (E side on River Ave)	Site # 11	16-Dec-99	9:48 a.m. to 10:47 a.m.	6	47	6	NW	Sunny	Small amount of traffic interference. Particulates from TP burner 350m W of MAML.
			21-Mar-00	6:16 p.m. to 7:18 p.m.	8	27	11	W	0%	Sunny.
			23-Mar-00	9:58 a.m. to 11:06 a.m.	1	99	8	SW	100%	Snowing.
			12-Jul-00	7:53 a.m. to 8:55 a.m.	21	42	4	W	10%	E side of sawmill, downwind of burner. Ferceline 30m W of MAML. No smoke from burner. Sawmill odours. 9:18AM - SO_2 readings ~1.5 km. E & S of Shell on Twp 252. 9:24AM - SW side of Shell ~30m from fenceline. SO_2 in whole area but especially around Shell.
			27-Sep-00	3:51 p.m. to 4:50 p.m.	24	18	11	SW	Sunny	E side of sawmill. No stack activity. Sawmill odour.
	Burnco Rock Products (W side on River Ave)	Site # 12	17-Dec-99	10:22 a.m. to 11:21 a.m.	-2	66	6	V	90%	Downwind of Burnco Rock Products which is the next block E of sawmill. Picking up particulates. Light cement truck activity. Fine cement dust on plant property roads.
	Shell Jumping Pound Gas Plant (Rge Rd 51 & Twp Rd 252)	Site # 13	12-Jul-00	9:47 a.m. to 10:51 a.m.	24	42	7	SE	Sunny	1.4 km S of Shell.
	Domtar excavation (1 Block S of Railway St on 2nd Ave)	Site # 14	26-Sep-00	2:42 p.m. to 3:41 p.m.	25	17	5	SE	Sunny	No Comments from the MAML operator.
	Shell Jumping Pound Gas Plant (Rge Rd 50 & Twp Rd 252)	Site # 15	27-Sep-00	2:32 p.m. to 3:31 p.m.	24	18	20	W	Sunny	Stack is about 3km NW of MAML
Exshaw	Municipal District of Bighorn #8 Building	Site # 16	15-Dec-99	11:27 a.m. to 12:28 p.m.	-2	68	17	NE	n/a	No Comments from the MAML operator.
			12-Jul-00	12:00 p.m. to 1:00 p.m.	27	20	14	SE	Sunny	
				1:00 p.m. to 2:00 p.m.	28	17	14	SE	n/a	
				2:01 p.m. to 3:00 p.m.	29	16	15	E	n/a	
				3:01 p.m. to 3:49 p.m.	29	15	16	NE	n/a	
	Mt McGillivery Dr & Heart Mtn Dr on N side of Hwy 1A	Site # 17	15-Dec-99	1:05 p.m. to 2:11 p.m.	-1	73	13	SW	n/a	
			16-Dec-99	1:39 p.m. to 2:48 p.m.	6	41	15	SW	60%	
			21-Mar-00	3:13 p.m. to 4:09 p.m.	9	22	27	W	n/a	400m from Baymag stack.
			27-Sep-00	11:17 a.m. to 12:16 p.m.	20	29	17	W	n/a	The Lafarge stack is ~800m-1km NW of MAML.

Table A.9 Weather conditions and MAML operator's comments at monitoring sites in Exshaw.

Area	Monitoring Location	Site #	Date	Monitoring Time (MST)	Temp. (°C)	RH (%)	Wind Spd. (km/h)	Wind Dir.	Cloud Cover	Comments from MAML Operator
Exshaw	2.5 km E of Exshaw @ Kananaskis Village	Site # 18	16-Dec-99	3:10 p.m. to 4:09 p.m.	5	50	25	SW	n/a	On Hwy 1A ~1 km downwind of Graymont which is 2.6 km E of Exshaw. Detecting SO_2 from Lafarge as well.
			21-Mar-00	4:23 p.m. to 5:23 p.m.	9	21	25	SW	n/a	600m NE of Graymont. Not downwind of Graymont but still picking up some SO_2 & particulate from Exshaw which is 2.5 km W.
			22-Mar-00	2:52 p.m. to 3:52 p.m.	12	34	20	SW	n/a	No comments from the MAML operator.
			11-Jul-00	1:50 p.m. to 2:51 p.m.	24	26	20	SW	n/a	20m S of Hwy 1A & 1 km downwind of Graymont. Lots of particulate.
	Access Rd to Continental Lime		08-Aug-00	8:31 a.m. to 9:34 a.m.	17	57	13	SW	clear	No Comments from the MAML operator.
	2.5 km E of Exshaw @ Kananaskis Village		08-Aug-00	7:25 a.m. to 8:27 a.m.	13	74	13	SW	clear	Mostly downwind of Graymont. Plume from Graymont coming directly at MAML.
			26-Sep-00	8:38 a.m. to 9:37 a.m.	12	48	28	SW	n/a	Downwind of Graymont.
			27-Sep-00	12:23 p.m. to 1:22 p.m.	21	26	18	SW	n/a	Downwind of Graymont. Wind directly from Graymont. Elevated readings on most parameters. There may be some traffic influence from the highway, however winds from the SW are from Graymont. The odour from this plant is different from Lafarge.
	Lac Des Arc	Site # 19	21-Mar-00	12:53 p.m. to 1:53 p.m.	11	24	6	SW	n/a	Downwind of Lafarge - plant across the river.
				1:54 p.m. to 2:54 p.m.	12	21	6	S	n/a	No comments from the MAML operator.
	T-Intersection S side of Hwy 1A across railway tracks	Site # 20	22-Mar-00	9:54 a.m. to 10:53 a.m.	8	29	12	SW	20%	~400m to 1 km downwind from Baymag stack.
				10:54 a.m. to 11:54 a.m.	11	26	16	W	n/a	No Comments from the MAML operator.
				11:54 a.m. to 12:55 p.m.	12	28	22	W	20%	
				12:56 p.m. to 1:56 p.m.	12	30	25	W	n/a	
				1:57 p.m. to 2:47 p.m.	13	30	25	SW	n/a	
			26-Sep-00	9:51 a.m. to 10:50 a.m.	13	47	16	NW	n/a	~1km downwind of main stack. Sunny.
				10:51 a.m. to 11:50 a.m.	17	35	13	NW	n/a	No comments from the MAML operator.
	Community Hall @ Heart Mtn Dr & Barrier Mtn Dr	Site # 21	11-Jul-00	11:34 a.m. to 12:34 p.m.	23	27	17	SW	80%	No rain.
				12:35 p.m. to 1:34 p.m.	23	27	16	SW	n/a	No Comments from the MAML operator.
			08-Aug-00	10:45 a.m. to 11:46 a.m.	25	31	5	SW	n/a	Smell of burning rubber in the air.
	Grotto Mtn Picnic area	Site # 22	08-Aug-00	12:12 p.m. to 1:12 p.m.	28	22	6	S	n/a	No Comments from the MAML operator.
				1:12 p.m. to 2:13 p.m.	29	20	6	S	n/a	

* Weather conditions are based on observations at the monitoring site.

Appendix B – Hourly Particulate Data Collected at the Exshaw Station

July 2000 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
11	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
12	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	10	31	16	14	14	17	17
13	21	25	26	19	19	23	27	27	26	28	25	14	21	21	25	18	16	22	31	19	16	20	11	10	21
14	15	18	14	17	20	15	13	14	12	13	13	16	16	18	16	24	10	6	7	5	5	7	10	23	14
15	22	14	19	19	7	5	3	8	7	4	5	6	18	8	6	11	8	7	4	6	6	8	9	6	9
16	7	7	6	5	7	10	14	14	10	9	8	9	10	8	8	8	9	8	7	7	13	10	12	10	9
17	10	9	7	20	12	11	15	21	36	17	20	16	16	18	20	15	15	15	14	12	15	16	15	14	16
18	16	13	15	26	35	34	25	24	28	25	21	10	11	18	16	35	24	22	16	16	17	19	15	13	21
19	14	7	8	8	9	11	21	30	26	21	12	14	18	14	13	21	16	15	13	12	16	7	6	10	14
20	13	10	14	19	26	27	25	29	19	29	18	7	8	18	18	15	18	3	7	10	10	16	8	9	16
21	10	18	10	11	14	16	13	12	18	14	17	16	7	13	12	17	19	9	12	23	26	13	11	11	14
22	22	21	22	20	16	21	20	23	21	19	15	9	11	9	9	12	15	11	8	13	174	16	21	21	23
23	14	5	9	10	8	10	13	21	29	5	4	6	6	8	10	14	6	8	11	10	10	6	3	3	10
24	14	5	9	10	8	10	13	21	29	5	4	6	6	8	10	14	6	8	11	10	10	6	3	3	10
25	14	15	10	8	11	12	14	14	13	14	7	6	13	12	9	17	14	21	25	14	13	9	6	8	12
26	10	7	10	12	9	20	16	13	18	23	14	11	13	12	13	17	17	23	23	28	9	8	8	14	15
27	19	20	21	13	11	12	11	14	12	20	33	26	20	16	12	12	10	9	18	14	12	7	7	7	15
28	7	6	7	7	7	7	9	9	9	14	9	7	7	9	9	7	19	11	13	8	7	12	17	10	9
29	13	15	8	8	12	14	8	6	6	9	9	7	1	3	5	5	11	25	16	10	10	7	5	6	9
30	6	10	10	11	10	14	15	22	27	26	15	16	16	13	13	13	13	14	13	9	10	12	16	9	14
31	20	24	21	20	21	24	21	21	21	23	16	22	18	9	13	13	11	12	9	118	7	8	12	10	21

n/a Data not available due to instrument malfunction.

August 2000 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	12	12	12	22	17	19	23	21	29	24	23	12	20	11	5	14	51	23	21	17	12	8	4	7	17
2	10	11	10	9	23	19	20	23	21	13	12	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	16
3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	4	3	6	8	13	15	17	23	22	17	14	7	19	22	17	16	19	25	10	9	12	10	11	11	14
9	10	12	12	11	11	11	12	18	18	21	21	21	21	22	1	6	8	12	14	16	8	7	10	24	14
10	9	1/	34	31	22	18	16	16	15	11	14	15	15	16	11	17	17	15	22	16	17	11	11	11	17
11	12	10	6	16	7	13	9	10	16	11	21	24	17	16	15	6	6	16	20	15	14	13	5	n/a	13
12	3	4	4	5	6	4	8	7	5	5	9	7	10	11	11	13	17	15	12	14	13	12	11	10	9
13	9	10	4	22	18	14	16	22	25	19	19	19	16	15	11	7	9	13	1	11	4	2	6	6	12
14	6	4	5	9	11	10	13	11	19	13	9	2	5	8	5	7	15	13	14	23	1	10	8	12	10
15	17	16	19	18	18	15	13	23	29	28	16	14	16	10	18	19	18	60	6	9	9	11	17	19	18
16	12	9	10	11	8	9	12	20	27	17	10	10	6	7	22	13	12	13	13	11	14	12	11	11	13
17	14	13	11	14	24	23	26	27	31	29	16	22	30	23	13	26	26	29	35	29	22	30	38	46	25
18	41	41	45	46	46	49	46	52	53	49	56	37	19	15	18	17	21	29	13	10	14	11	18	19	32
19	19	16	23	29	13	7	10	23	18	9	12	6	19	12	15	18	12	5	7	7	14	13	4	2	13
20	10	8	9	9	15	7	11	12	3	1	1	2	9	6	9	15	17	16	16	17	14	10	7	7	10
21	5	5	6	31	33	10	9	13	7	5	8	8	16	13	17	14	29	44	32	29	32	13	4	5	16
22	7	7	12	17	15	16	17	19	29	18	9	8	5	12	27	38	33	9	20	22	20	26	40	26	19
23	11	10	9	10	11	16	19	21	28	26	21	5	16	27	26	23	35	30	44	32	9	8	14	11	19
24	13	11	13	11	13	15	26	28	25	20	11	14	29	24	22	13	18	n/a	25	3	7	9	13	17	17
25	13	11	13	11	13	15	26	28	25	20	11	14	29	24	22	13	18	n/a	25	3	7	9	13	17	17
26	9	11	11	14	20	20	23	31	18	15	6	61	8	4	11	32	1	9	n/a	4	5	4	4	3	14
27	5	7	7	8	5	2	4	5	4	4	4	4	5	3	4	4	4	4	4	2	16	16	11	10	6
28	7	12	14	7	9	8	10	11	14	14	5	6	11	25	22	31	22	25	26	22	16	5	4	7	14
29	11	11	15	18	18	8	13	23	25	30	15	17	12	12	12	9	8	4	10	9	10	5	3	4	13
30	3	2	3	3	4	2	n/a	1	25	30	15	12	13	14	12	11	9	8	9	10	7	10	8	7	9
31	7	8	16	15	13	11	17	27	21	21	13	19	12	10	13	9	14	6	7	9	4	4	10	14	13

n/a Data not available due to instrument malfunction.

September 2000 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	13	18	26	34	23	15	18	20	23	20	33	21	13	19	19	24	25	20	20	13	2	5	4	8	18
2	3	4	3	3	8	4	8	6	4	3	5	5	4	3	6	6	7	5	3	4	4	2	2	2	4
3	2	3	6	7	5	2	3	3	5	6	9	11	9	7	4	6	5	7	6	7	8	6	5	7	6
4	4	7	5	4	5	6	8	11	12	12	8	8	1	1	5	5	2	2	5	11	11	13	17	15	7
5	12	12	10	6	9	8	6	14	10	12	5	8	10	7	9	8	7	13	13	14	7	3	4	4	9
6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
7	7	6	6	6	7	9	13	23	13	16	10	18	20	14	11	10	11	10	3	4	6	12	13	20	11
8	7	14	15	17	17	7	12	6	2	2	7	2	9	6	6	n/a	14	5	10	4	8	9	6	10	8
9	7	8	7	7	9	10	10	5	6	4	1	3	3	2	4	4	5	5	6	4	4	2	4	3	5
10	11	18	16	10	7	5	12	11	2	2	3	3	3	5	5	4	5	14	17	10	7	6	8	10	8
11	6	5	6	10	9	6	9	11	7	7	33	29	19	26	29	34	36	28	31	35	17	7	12	9	18
12	6	6	7	7	7	6	7	9	11	9	6	12	15	9	18	23	14	12	20	26	10	6	9	13	11
13	10	10	11	11	12	10	12	17	14	16	16	9	10	6	10	12	11	10	19	25	17	23	26	19	14
14	16	12	12	14	11	12	20	14	16	22	23	27	17	26	16	19	5	21	17	16	17	20	13	13	17
15	17	13	23	18	19	17	27	23	25	26	19	19	22	25	19	14	13	3	9	8	14	13	16	18	18
16	15	13	12	16	19	15	20	21	23	17	16	17	15	6	9	9	9	10	8	19	29	15	15	19	15
17	26	23	25	21	13	15	21	20	15	11	8	6	10	10	17	7	12	18	13	5	6	3	7	15	14
18	17	8	10	8	2	12	9	15	13	10	6	5	10	6	n/a	20	14	8	11	6	1	13	13	13	10
19	7	12	19	19	7	12	13	23	13	10	9	12	11	13	11	n/a	n/a	n/a	12	10	16	18	5	9	12
20	13	9	8	8	8	10	11	15	19	17	18	15	16	16	11	7	2	6	6	4	2	3	1	2	9
21	n/a	3	2	3	5	4	7	3	5	6	9	5	8	8	6	5	5	5	5	4	4	4	5	5	5
22	5	6	7	4	6	7	3	5	12	8	12	11	10	14	18	24	14	12	4	5	10	12	9	6	9
23	6	8	5	7	15	11	8	11	10	18	26	16	17	12	12	17	6	6	4	9	8	11	15	13	11
24	11	11	11	14	14	15	16	11	11	17	18	12	11	7	10	21	12	4	6	7	11	14	13	12	12
25	11	13	10	12	9	15	13	13	14	15	14	19	19	15	18	35	18	2	5	17	17	13	10	8	14
26	9	9	9	10	12	14	13	15	14	21	22	19	13	11	17	9	10	12	18	30	25	15	20	15	15
27	17	13	15	16	14	12	13	14	26	23	21	17	12	9	8	11	9	15	26	31	28	18	13	11	16
28	9	9	13	14	10	13	22	32	22	17	34	20	16	17	29	35	29	19	13	27	15	13	9	8	19
29	7	8	9	14	20	17	24	35	28	25	18	14	19	10	6	6	19	19	8	6	6	2	3	4	14
30	2	1	1	4	7	7	8	10	6	4	7	19	19	n/a	n/a	n/a	9	1	10	12	6	5	10	9	7

n/a Data not available due to instrument malfunction.

October 2000 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	15	20	7	9	17	9	7	16	5	5	14	12	3	5	7	3	8	5	9	14	7	6	4	2	9
2	3	9	6	8	8	13	12	14	10	6	8	7	6	9	9	11	12	11	11	10	6	8	7	7	9
3	6	5	5	5	6	8	6	6	9	10	7	7	6	9	8	9	11	8	10	7	17	18	14	8	9
4	13	16	11	7	3	3	4	6	6	4	30	207	73	4	2	5	8	5	9	7	12	9	5	6	19
5	7	8	10	17	14	14	19	20	24	12	21	18	20	19	18	16	16	14	11	10	7	7	11	11	14
6	12	13	10	11	11	9	12	20	31	20	34	29	31	36	23	23	13	7	7	9	18	13	10	14	17
7	9	12	9	14	12	12	19	17	22	37	31	24	38	29	14	9	22	11	5	10	12	19	13	12	17
8	10	9	9	12	15	12	15	13	28	13	17	21	8	10	14	13	8	12	16	13	9	8	13	13	13
9	10	11	15	14	11	14	23	23	21	14	14	22	24	16	13	11	15	14	12	11	20	27	21	15	16
10	19	27	20	18	28	27	28	40	30	31	23	22	18	23	18	18	21	11	17	18	13	13	26	20	22
11	16	23	22	24	10	11	16	33	43	42	31	38	17	14	15	22	17	21	24	18	21	9	24	30	23
12	35	33	19	26	23	24	23	26	25	24	26	26	22	6	13	15	10	20	20	14	13	14	8	10	20
13	25	30	20	16	17	23	21	28	33	24	23	19	19	10	13	11	13	15	15	15	14	14	16	14	19
14	23	22	14	15	17	15	19	20	19	25	24	20	27	17	11	19	17	14	13	5	7	12	17	17	17
15	9	9	6	5	4	4	4	7	7	12	5	10	6	2	4	2	6	6	8	5	4	5	8	6	6
16	17	6	5	12	8	3	10	9	14	11	12	13	5	9	10	9	7	11	6	5	6	7	8	12	9
17	9	8	4	7	9	10	8	6	11	13	20	5	8	1	6	12	25	15	11	33	23	44	17	25	14
18	34	25	32	59	15	26	8	7	7	2	2	13	10	19	11	10	6	5	14	16	12	1	1	1	14
19	3	10	7	10	8	7	9	15	11	11	20	27	25	16	17	10	8	7	5	5	11	19	19	23	13
20	11	17	22	6	8	7	5	10	14	25	22	14	27	27	13	6	5	5	5	13	13	9	3	4	12
21	2	6	1	1	3	7	10	6	9	5	6	2	11	2	5	10	1	2	4	7	5	6	2	2	5
22	3	2	1	2	1	3	2	2	5	2	3	5	16	10	8	3	6	4	5	4	2	2	2	2	4
23	3	6	4	8	5	6	12	8	8	6	6	5	7	5	4	5	10	11	9	16	12	8	7	8	7
24	6	6	5	5	5	8	7	15	15	17	33	30	15	23	12	11	8	6	7	12	23	37	29	21	15
25	29	32	27	34	14	13	24	28	34	15	18	20	17	16	15	13	11	11	14	15	19	13	17	14	19
26	24	20	21	18	18	18	25	30	30	23	21	24	16	17	13	10	9	13	19	14	16	8	10	16	18
27	18	18	18	19	12	11	12	12	16	18	18	19	20	20	n/a	n/a	10	8	6	4	6	6	7	6	13
28	4	4	6	12	14	13	14	19	16	18	16	16	20	16	10	8	6	9	7	5	5	4	9	5	11
29	8	6	8	10	10	8	11	6	13	14	7	4	3	3	5	5	5	11	9	11	9	7	6	7	8
30	15	10	12	9	11	10	11	13	11	11	11	11	6	7	9	5	8	20	18	18	22	16	12	6	12
31	5	7	4	4	4	5	5	7	9	8	9	12	17	18	13	16	21	19	11	8	7	8	11	14	10

n/a Data not available due to instrument malfunction.

November 2000 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	9	7	7	12	10	10	11	7	10	10	5	6	5	8	6	9	12	10	9	9	8	9	7	7	8
2	7	10	8	7	7	12	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	9
3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
6	9	11	11	10	9	9	11	13	13	14	12	13	14	22	14	13	18	16	8	9	4	2	8	13	12
7	10	12	10	9	9	10	13	22	24	14	16	7	5	7	7	5	5	6	6	6	6	8	12	17	10
8	18	16	10	12	12	12	9	12	16	17	19	14	15	23	9	8	5	10	18	20	16	16	15	17	14
9	19	20	19	16	16	17	17	17	15	15	17	17	16	15	29	15	22	15	13	12	12	12	10	11	16
10	14	12	10	13	15	14	14	15	16	14	12	17	17	52	81	14	11	15	15	16	16	20	17	11	19
11	16	19	15	15	14	15	12	18	22	24	20	17	13	11	9	7	10	12	9	8	8	11	15	17	14
12	16	15	15	14	13	18	15	13	11	13	14	17	21	24	26	16	8	7	7	8	9	11	9	10	14
13	10	9	10	10	10	9	10	10	11	17	22	21	13	11	10	13	16	14	16	22	15	14	13	12	13
14	12	13	11	10	10	8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	11
15	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
16	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
17	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
18	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
19	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
20	19	26	27	24	24	19	13	9	11	12	26	30	19	21	18	10	13	12	12	10	12	11	15	14	17
21	19	26	27	24	24	19	13	9	11	12	14	13	11	10	13	17	9	8	9	13	13	12	10	9	14
22	14	9	13	11	9	13	11	9	10	14	11	n/a	n/a	10	11	8	9	10	8	9	9	11	11	8	10
23	20	20	21	18	22	13	11	9	15	23	22	38	32	18	18	18	16	18	6	5	9	12	17	14	17
24	11	9	12	14	10	15	7	6	6	7	9	9	11	7	9	16	15	13	7	7	5	6	4	5	9
25	8	8	8	6	6	5	4	5	7	13	9	8	10	6	5	5	4	4	3	5	4	3	5	5	6
26	4	5	3	3	10	3	4	7	4	7	11	4	3	4	4	4	5	6	9	5	4	3	5	6	5
27	12	5	4	10	7	7	12	9	7	12	12	6	5	7	10	9	6	7	9	6	8	8	6	9	8
28	6	4	4	6	6	5	5	4	7	7	11	13	5	5	8	8	17	13	3	4	8	6	7	8	7
29	5	9	7	9	7	5	7	8	11	16	16	8	10	15	15	18	15	11	11	7	5	7	8	10	10
30	10	10	15	19	15	17	13	14	13	12	11	7	5	8	6	6	6	5	5	5	4	5	4	5	9

n/a Data not available due to instrument malfunction.

December 2000 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	5	5	5	6	4	5	4	5	7	8	7	8	12	9	6	7	11	9	6	5	5	5	6	6	7
2	6	7	7	7	4	5	6	6	7	8	10	15	14	12	6	3	6	7	6	5	4	5	8	6	7
3	8	3	5	4	9	6	7	4	4	5	3	3	4	5	6	4	6	9	9	5	7	8	9	6	6
4	6	8	12	9	6	12	17	23	16	18	18	17	19	14	19	15	11	11	9	8	13	26	24	15	14
5	10	10	7	9	6	6	8	10	15	17	9	9	12	16	21	12	13	17	18	14	27	28	16	12	13
6	11	13	22	22	10	8	9	10	14	10	24	14	29	24	12	5	4	4	5	5	8	15	17	20	13
7	13	9	2	4	6	4	5	4	5	5	6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	6
8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
11	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
12	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
13	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
16	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
17	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
18	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25	19	16	11	9	10	10	14
19	9	7	10	5	5	5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12	9	6	6	7	9	15	14	8
20	9	10	4	5	6	8	12	8	9	11	12	15	11	16	15	11	9	9	6	8	6	6	5	7	9
21	5	5	5	7	6	4	4	4	5	5	8	7	17	24	22	22	16	16	13	13	9	13	19	12	11
22	11	13	10	9	9	6	11	8	14	12	14	8	12	18	24	15	13	19	20	18	23	23	26	28	15
23	31	30	27	25	16	17	19	7	7	15	9	6	6	9	7	6	6	6	6	9	9	7	10	8	12
24	9	10	7	8	7	4	4	5	5	6	9	11	6	12	8	5	9	11	7	7	7	7	8	6	7
25	8	6	5	6	4	3	3	4	4	6	10	7	7	5	3	2	9	5	5	7	10	9	5	6	6
26	5	6	3	5	5	5	7	11	20	11	17	17	12	6	4	4	6	12	18	17	17	15	13	10	10
27	9	7	8	5	10	5	9	10	12	10	9	4	7	7	8	8	12	17	15	9	10	7	7	6	9
28	6	3	4	8	9	5	7	7	11	10	10	12	8	14	12	8	5	5	7	9	8	8	5	5	8
29	8	10	15	8	10	9	11	13	9	9	10	8	5	9	10	9	5	4	4	5	5	6	7	7	8
30	6	6	7	8	8	10	12	7	7	14	14	9	6	8	6	6	7	5	6	6	7	7	4	5	8
31	5	4	5	11	7	7	7	15	11	10	8	10	12	14	9	11	9	7	5	5	5	7	8	9	8

n/a Data not available due to instrument malfunction.

January 2001 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	8	9	6	5	7	9	7	9	7	10	7	4	4	7	6	6	6	4	5	4	4	5	8	6	6
2	4	4	6	8	4	8	5	9	13	13	10	9	7	5	7	9	9	10	5	6	4	5	3	3	7
3	4	5	3	7	8	7	4	12	10	13	13	16	9	5	6	6	11	6	5	7	6	5	5	4	7
4	2	3	7	10	11	9	16	18	16	22	24	24	21	18	18	17	10	15	13	20	13	6	4	5	13
5	6	2	3	5	7	5	5	7	7	8	7	5	4	2	1	1	2	6	12	9	10	8	7	4	6
6	5	4	6	6	4	3	3	5	6	7	7	7	4	6	8	5	6	8	9	12	13	11	12	9	7
7	9	7	8	7	8	5	6	5	7	10	10	8	5	6	6	5	4	4	4	4	5	4	7	9	6
8	14	9	8	7	8	9	7	8	10	9	10	9	9	11	15	15	15	12	10	10	9	6	6	7	10
9	5	7	14	13	9	5	6	9	9	7	9	13	14	7	11	5	5	5	4	7	9	9	12	13	9
10	14	9	10	11	6	5	6	7	14	9	15	12	18	12	10	8	8	16	12	11	13	6	10	12	10
11	7	6	7	7	4	5	6	8	13	14	15	16	14	13	16	12	17	13	12	13	16	7	8	10	11
12	12	10	8	8	10	9	8	10	10	10	13	20	24	15	12	21	18	13	12	13	12	12	8	12	12
13	13	15	23	13	13	13	15	13	15	13	14	16	14	15	14	8	8	10	7	7	8	8	8	7	12
14	8	9	11	8	10	9	8	10	9	8	9	9	7	8	9	14	8	12	12	6	12	10	12	17	10
15	13	15	9	8	10	9	13	11	11	9	10	9	11	8	11	6	8	4	5	6	13	18	13	10	10
16	13	11	13	10	9	9	10	12	8	8	8	10	13	13	16	13	23	15	8	5	12	9	17	17	12
17	9	14	17	16	16	17	18	11	13	9	10	13	15	17	15	13	6	7	6	9	7	7	9	9	12
18	9	9	9	10	9	8	9	9	11	10	10	12	15	15	9	7	8	7	8	8	11	11	11	14	10
19	11	25	27	14	14	12	11	7	10	9	12	13	13	n/a	n/a	n/a	13	13	10	8	7	9	9	8	12
20	8	11	11	9	9	10	8	5	6	4	5	10	14	8	13	17	9	24	16	6	4	6	6	6	9
21	7	8	9	9	6	5	6	6	6	6	9	7	7	5	6	8	9	8	6	9	10	8	9	8	7
22	8	10	11	14	11	17	14	14	15	9	9	11	13	16	14	16	14	13	10	12	8	7	8	8	12
23	12	8	6	5	6	7	8	9	10	8	10	11	17	16	14	13	16	12	11	12	12	13	13	14	11
24	11	11	11	12	11	9	7	9	9	9	10	9	13	12	10	15	8	7	9	8	11	13	8	7	10
25	12	17	13	23	15	13	19	10	22	20	11	12	8	7	7	12	13	13	11	8	9	10	8	7	12
26	6	6	5	6	6	6	6	10	10	10	10	10	7	11	13	14	19	14	14	12	9	7	6	7	9
27	6	6	6	6	8	14	11	10	11	5	10	14	6	8	9	8	12	6	9	12	11	17	21	31	11
28	23	18	16	20	16	19	15	18	8	8	10	10	11	8	5	15	12	12	14	11	7	6	6	5	12
29	6	7	16	15	8	5	5	5	7	6	10	4	18	20	7	9	5	6	6	7	25	13	6	8	9
30	9	12	11	12	9	7	13	8	8	10	4	5	12	17	13	10	12	11	10	6	6	4	4	11	9
31	11	10	10	7	9	4	5	10	10	8	7	11	9	5	9	14	17	18	14	7	11	11	9	8	10

n/a Data not available due to instrument malfunction.

February 2001 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	5	6	5	6	7	7	7	18	14	14	14	10	25	22	24	17	14	20	11	9	10	9	10	8	12
2	9	11	8	8	3	5	8	11	7	6	5	4	4	5	5	6	10	11	11	14	7	7	4	5	7
3	5	5	6	8	9	17	17	10	8	8	8	8	13	13	9	11	6	9	5	5	8	5	10	8	9
4	13	14	11	5	4	6	8	5	5	7	3	2	3	3	5	8	4	8	8	6	16	12	15	12	8
5	5	16	10	13	10	19	10	9	12	7	7	6	4	4	5	5	5	7	5	8	5	2	8	9	8
6	10	6	9	9	7	10	8	11	7	7	7	2	3	3	3	4	10	22	7	9	8	9	10	4	8
7	8	6	5	5	5	5	7	8	8	6	4	2	2	4	4	11	9	10	8	10	9	10	10	13	7
8	6	12	9	8	11	6	10	13	8	11	7	19	10	5	11	12	11	7	8	11	14	15	16	14	11
9	12	7	6	7	11	14	12	15	16	17	6	n/a	n/a	6	19	23	20	17	18	15	15	3	4	5	12
10	7	9	12	10	7	8	8	4	6	6	1	2	5	6	8	7	10	14	15	16	16	18	12	12	9
11	20	19	18	25	22	10	19	30	22	16	12	13	19	20	18	16	16	13	19	16	13	17	15	14	18
12	13	14	12	13	9	6	6	15	17	18	10	9	5	10	11	13	12	10	8	12	18	19	14	13	12
13	10	17	17	6	39	17	7	4	8	5	3	4	6	5	5	3	3	5	5	4	3	4	5	6	8
14	10	10	8	6	8	17	18	17	11	7	8	9	5	6	15	13	8	19	75	81	35	27	20	19	19
15	7	7	10	10	8	11	12	7	6	3	3	7	4	5	3	3	6	9	5	8	7	6	8	11	7
16	12	4	2	8	8	6	6	7	7	4	5	2	9	4	5	7	14	10	6	5	9	9	4	8	7
17	8	7	6	5	4	7	7	9	8	7	6	4	4	5	8	5	4	9	8	7	5	4	5	8	6
18	7	6	7	6	4	5	8	8	11	8	10	5	4	7	7	8	5	7	13	8	6	9	7	7	7
19	8	6	7	14	15	12	6	7	7	7	10	10	14	9	7	7	9	11	12	9	7	11	10	11	9
20	17	17	12	8	9	6	10	7	8	3	1	6	5	4	8	4	3	16	3	5	4	6	6	7	7
21	8	10	8	6	4	5	5	6	6	4	4	4	13	23	21	25	13	13	10	14	13	14	12	9	10
22	7	11	8	5	6	4	4	12	2	2	1	4	3	7	6	4	5	6	5	5	5	6	7	6	5
23	7	6	7	3	6	6	7	5	8	6	9	11	14	18	15	10	10	9	7	7	6	6	5	6	8
24	4	4	5	7	5	2	11	6	3	5	5	4	4	3	7	3	6	11	5	8	7	4	5	10	6
25	10	9	8	7	5	5	8	9	10	5	4	1	10	17	13	10	12	12	13	7	16	23	23	13	10
26	14	13	12	16	12	15	15	25	24	12	11	12	7	2	6	7	5	10	6	3	4	5	5	6	10
27	3	7	6	5	2	5	3	2	3	0	2	3	4	4	4	3	3	4	3	5	3	4	5	4	4
28	8	2	4	4	6	8	7	3	6	6	1	1	2	3	3	6	6	6	6	6	6	7	7	9	5

n/a Data not available due to instrument malfunction.

March 2001 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	8	10	7	2	5	4	6	6	4	5	6	5	2	5	5	4	6	9	9	5	2	6	6	9	6
2	8	4	2	3	4	4	4	7	7	5	12	5	4	2	2	4	5	6	6	5	5	6	3	5	5
3	7	5	7	6	6	4	5	6	4	3	1	3	3	4	4	4	4	7	10	6	4	4	4	5	5
4	6	5	4	6	7	7	9	9	8	5	4	5	2	1	4	5	8	8	9	7	5	8	9	8	6
5	10	6	6	7	6	5	8	8	9	7	9	7	8	6	4	5	5	6	7	17	14	20	17	11	9
6	15	27	27	28	11	6	10	5	3	3	1	1	2	4	3	4	6	8	10	4	5	5	5	5	8
7	4	5	6	4	4	2	4	3	2	3	4	7	4	5	3	2	4	6	12	8	6	10	9	9	5
8	9	8	6	6	5	5	4	5	4	3	2	1	5	6	9	6	6	7	8	7	12	12	23	15	7
9	12	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12
10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
11	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
12	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
13	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
16	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
17	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
18	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
19	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
20	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
21	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
22	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
23	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
24	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
25	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
26	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	14	8	5	3	10	10	5	9	9	8
27	14	12	12	9	5	8	8	12	16	16	17	11	10	10	18	11	10	8	8	8	17	25	23	23	13
28	13	12	11	16	6	9	14	13	12	6	14	21	17	13	11	14	13	14	6	8	11	8	10	10	12
29	5	7	7	12	10	15	23	26	30	24	8	10	4	15	13	10	12	5	12	13	13	18	11	10	13
30	6	13	6	5	9	8	9	14	14	13	26	n/a	n/a	n/a	8	13	13	10	n/a	7	7	12	11	9	10
31	6	14	19	5	14	16	22	23	19	16	19	13	6	7	9	8	9	4	7	4	3	9	10	7	11

n/a Data not available due to instrument malfunction.

April 2001 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	10	12	10	12	13	8	12	11	17	18	17	14	10	14	16	5	5	8	10	12	9	9	8	9	**11**
2	9	10	10	13	13	13	18	17	20	19	13	26	13	12	13	10	13	15	17	18	14	13	9	8	**14**
3	14	12	13	19	19	13	16	14	16	31	36	12	20	14	16	12	18	18	21	25	20	16	12	20	**18**
4	17	15	17	17	14	11	18	18	25	31	25	23	21	25	22	20	8	14	10	19	15	12	18	14	**18**
5	15	19	18	15	15	22	26	34	20	34	37	26	25	n/a	n/a	n/a	11	8	9	5	4	3	3	4	**17**
6	12	20	9	6	11	16	24	28	23	17	15	10	17	9	9	11	12	10	13	10	6	8	13	13	**13**
7	11	11	10	7	11	8	10	13	12	8	7	11	7	9	20	10	13	15	17	14	10	12	12	13	**11**
8	15	15	15	12	13	15	14	13	9	5	5	4	5	4	7	10	15	22	25	20	17	18	17	20	**13**
9	12	10	15	12	14	12	10	9	9	11	7	2	6	10	7	9	8	6	7	10	11	11	7	4	**9**
10	4	3	7	11	11	7	10	7	5	6	8	8	5	4	5	7	6	7	11	9	4	4	5	7	**7**
11	7	6	6	4	6	6	8	7	6	6	5	7	8	10	13	10	11	10	9	7	7	7	7	10	**8**
12	11	11	9	6	6	8	8	9	12	14	14	14	19	11	14	10	9	9	10	9	13	7	14	8	**11**
13	7	7	6	11	10	7	9	11	14	16	15	7	9	14	8	9	9	6	6	8	8	8	8	8	**9**
14	9	8	8	8	8	11	13	13	9	15	13	9	12	16	16	15	12	14	11	9	9	10	11	11	**11**
15	10	10	12	18	14	11	6	7	7	7	10	11	11	10	11	12	8	11	12	14	14	13	12	11	**11**
16	12	13	11	11	11	11	26	29	29	28	31	21	20	31	16	17	25	8	10	11	9	16	15	10	**17**
17	15	12	15	14	17	18	22	23	29	47	35	22	19	18	20	14	10	10	10	6	6	7	13	11	**17**
18	4	4	3	5	5	7	12	13	17	24	18	20	24	23	35	31	22	14	9	13	9	7	12	10	**14**
19	11	7	8	21	9	9	9	10	12	10	15	17	16	15	17	9	15	10	18	10	10	7	10	16	**12**
20	16	6	6	7	6	8	10	11	12	12	9	8	7	10	7	8	10	8	7	6	9	9	8	8	**9**
21	7	7	11	9	5	9	13	15	13	16	15	16	21	12	9	11	8	11	7	9	8	9	8	9	**11**
22	8	8	8	9	8	8	9	13	10	6	10	6	7	9	8	10	9	8	8	7	9	9	7	7	**8**
23	10	12	9	9	13	11	16	14	17	14	15	14	22	22	17	11	10	11	7	10	9	7	5	6	**12**
24	6	5	6	7	5	7	11	29	28	19	25	32	22	25	15	9	9	7	9	8	15	9	10	29	**14**
25	44	23	24	23	22	17	17	20	10	9	16	16	10	14	9	6	16	11	11	8	12	12	11	15	**16**
26	11	13	17	29	22	21	32	36	25	26	20	23	20	13	12	15	14	15	25	15	10	11	11	8	**18**
27	10	17	14	8	9	12	14	13	17	12	14	16	6	7	10	10	10	8	12	7	6	12	20	8	**11**
28	9	9	17	11	9	9	8	8	8	7	9	5	9	3	4	7	6	9	9	3	2	3	2	4	**7**
29	10	8	8	10	8	7	5	5	4	8	11	8	8	5	7	6	12	9	5	8	9	6	3	3	**7**
30	7	7	7	5	5	7	10	4	12	7	7	10	7	12	13	5	8	11	8	15	13	9	4	3	**8**

n/a Data not available due to instrument malfunction.

May 2001 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	6	1	3	4	4	7	7	15	11	12	8	6	7	9	8	9	6	5	4	4	7	10	13	6	7
2	10	11	17	12	14	20	13	13	7	8	5	8	4	8	9	8	8	6	8	12	10	10	6	6	10
3	4	6	4	4	4	8	9	9	8	18	13	11	7	9	7	9	14	15	18	23	15	8	6	13	10
4	12	15	9	7	7	7	8	14	9	12	12	10	9	8	11	9	6	6	8	9	10	6	14	12	9
5	6	6	6	4	9	10	11	4	5	0	0	3	5	6	10	7	5	6	4	4	4	4	4	4	5
6	4	4	4	3	4	5	6	4	6	5	5	4	5	4	5	5	4	5	8	6	14	10	8	11	6
7	11	15	10	11	10	14	13	9	12	11	14	26	18	29	27	22	15	17	12	12	11	7	8	11	14
8	9	10	10	12	8	11	15	16	15	25	27	17	15	14	21	25	23	18	25	7	6	4	5	5	14
9	5	5	7	9	11	8	6	6	6	6	8	9	8	8	8	10	13	20	16	12	22	25	14	11	10
10	13	14	14	10	12	18	18	18	14	13	10	13	15	12	15	11	14	14	9	11	11	10	10	10	13
11	10	13	13	13	7	9	15	21	17	17	16	25	19	17	18	23	21	16	11	11	10	12	10	11	15
12	10	13	15	28	25	19	17	20	16	11	11	13	13	12	7	10	13	11	13	15	16	15	15	12	14
13	16	14	20	32	n/a	n/a	4	2	9	7	6	7	8	8	13	16	16	12	11	9	8	7	9	11	11
14	15	10	13	15	18	21	10	10	13	11	10	11	11	10	4	6	4	3	2	3	5	4	7	6	9
15	8	7	11	5	4	15	8	13	10	12	9	11	2	6	11	3	7	4	3	12	4	9	5	6	8
16	8	7	11	6	9	14	16	19	16	18	18	11	3	11	14	10	8	4	3	7	7	5	4	3	10
17	3	3	3	9	10	7	9	9	9	9	9	10	10	9	10	9	9	7	6	9	9	9	5	9	8
18	7	5	3	2	3	9	11	12	12	15	9	12	9	9	8	15	27	16	12	12	11	9	6	6	10
19	7	6	6	5	8	12	11	22	14	1	3	4	11	8	8	7	8	4	16	3	3	6	4	4	7
20	4	5	5	6	6	7	9	4	3	2	3	2	4	4	3	3	4	3	5	5	6	4	4	4	4
21	4	7	19	11	7	8	8	12	6	11	10	8	19	9	7	6	6	5	6	5	6	7	13	8	9
22	6	11	6	8	12	26	25	19	19	16	6	10	15	18	18	27	22	20	14	13	12	12	20	12	15
23	12	20	28	36	26	39	23	27	24	24	28	18	8	24	20	30	57	67	61	42	33	25	21	16	29
24	14	25	32	34	25	16	14	25	23	18	20	12	6	17	28	22	15	22	15	13	15	13	16	10	19
25	6	10	8	6	9	11	12	14	6	6	4	7	8	17	31	37	32	26	26	27	25	30	28	23	17
26	22	29	27	33	32	32	26	28	32	30	30	24	30	28	25	26	22	20	17	17	17	16	19	19	25
27	20	19	17	13	21	20	18	24	33	18	17	12	11	10	9	10	11	5	7	10	29	10	4	10	15
28	2	9	7	8	9	19	20	20	16	8	13	13	13	23	12	8	4	1	7	13	10	14	5	7	11
29	7	19	3	9	15	8	1	2	5	4	3	4	6	9	8	10	16	11	7	4	8	4	4	7	7
30	5	4	3	6	9	27	24	16	16	17	14	21	13	28	27	33	23	26	9	6	8	9	9	9	15
31	6	6	6	5	5	6	8	13	11	9	7	6	13	5	4	7	7	9	8	5	9	5	6	5	7

n/a Data not available due to instrument malfunction.

June 2001 Particulate ($PM_{2.5}$) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	8	10	11	12	10	15	18	24	16	14	13	13	6	7	9	5	10	4	4	6	9	18	26	7	12
2	6	2	n/a	n/a	n/a	n/a	n/a	10	19	1	7	5	10	7	5	5	14	7	6	2	4	6	4	4	6
3	3	6	7	5	7	4	5	8	4	5	9	3	4	5	5	8	8	7	10	13	10	6	6	6	6
4	4	3	3	5	2	5	15	7	6	4	3	7	8	8	3	5	5	4	12	7	6	5	3	2	5
5	1	2	2	1	5	7	6	4	5	2	n/a	2	3	0	1	1	5	4	3	3	3	4	3	6	3
6	4	6	4	3	7	8	11	18	16	13	4	11	10	8	6	3	1	7	6	8	7	5	6	4	7
7	9	8	8	9	7	6	9	11	2	4	8	9	6	8	10	17	13	4	4	1	8	8	7	8	8
8	6	6	4	5	8	8	20	16	13	10	3	7	8	5	8	8	12	10	6	8	6	6	4	8	8
9	8	10	8	10	11	11	13	24	14	13	17	5	12	8	12	14	n/a	n/a	n/a	n/a	n/a	n/a	2	4	11
10	3	4	7	7	4	6	5	9	1	2	1	4	13	n/a	n/a	2	7	3	3	4	2	1	1	3	4
11	2	2	3	3	4	9	9	11	11	11	8	10	11	6	8	11	13	6	6	8	7	10	5	4	7
12	3	5	4	5	4	8	6	6	5	7	9	8	11	16	22	16	15	20	19	14	15	13	10	9	11
13	8	9	7	20	9	9	14	20	21	22	10	8	11	14	6	6	13	10	7	4	9	6	4	5	11
14	5	7	5	7	8	9	6	15	12	10	9	8	2	14	8	10	7	10	9	7	n/a	3	3	6	8
15	5	5	6	5	6	10	8	12	12	10	10	9	11	14	8	6	5	4	2	6	9	2	4	2	7
16	1	3	5	4	4	3	5	5	4	4	5	4	5	7	5	15	8	2	9	6	7	8	5	3	5
17	3	2	4	4	5	5	7	12	6	1	7	4	4	11	4	4	4	10	7	2	2	3	2	2	5
18	1	11	9	8	9	8	8	7	8	8	3	11	9	3	9	16	2	5	6	7	2	2	7	9	7
19	8	4	5	5	4	5	7	9	11	10	11	9	7	5	4	8	8	7	9	9	5	5	6	7	7
20	6	6	5	6	7	7	8	15	21	12	9	11	8	10	8	8	8	8	12	12	13	15	23	12	10
21	8	9	8	7	9	9	24	32	26	29	16	16	14	21	20	19	14	9	7	7	6	7	4	2	13
22	12	11	13	19	12	16	20	15	17	20	1	14	6	13	17	13	13	14	5	11	6	10	25	13	13
23	12	9	8	10	9	4	3	4	5	4	8	11	10	9	12	11	15	6	n/a	n/a	n/a	5	16	28	9
24	9	8	14	13	7	6	16	16	n/a	n/a	4	7	4	4	41	16	13	7	1	5	5	8	8	8	10
25	7	17	5	1	6	4	7	7	8	3	5	7	9	9	15	4	10	5	5	4	25	11	6	6	8
26	4	6	8	8	6	3	6	8	15	8	8	4	2	5	6	8	8	7	8	8	5	5	7	6	6
27	10	9	17	6	7	14	11	18	14	12	11	17	17	28	18	21	18	1	0	5	8	1	2	4	11
28	4	10	4	9	6	5	4	6	n/a	8	7	4	9	2	11	3	6	n/a	n/a	8	5	6	9	9	6
29	12	8	5	5	3	8	8	13	10	7	4	6	12	19	8	8	6	11	8	8	6	7	7	9	8
30	10	9	9	7	7	7	10	11	9	10	9	14	10	5	6	10	13	13	6	8	7	8	9	15	9

n/a Data not available due to instrument malfunction.

July 2001 Particulate (PM_{10}) Data ($\mu g/m^3$) *

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	*10*	*5*	*n/a*	*7*	*5*	*9*	*7*	*13*	*n/a*	*n/a*	*15*	*12*	*8*	*9*	*12*	*15*	*10*	*8*	*8*	*6*	*50*	*25*	*10*	*11*	**12**
2	*13*	*9*	*5*	*13*	*12*	*14*	*14*	*19*	*22*	*12*	*14*	*13*	*5*	*15*	*12*	*10*	*10*	*9*	*15*	*4*	*6*	*12*	*19*	*13*	**12**
3	*10*	*10*	*11*	*14*	*16*	*23*	*49*	*22*	*22*	*19*	*19*	*21*	n/a	n/a	29	22	23	24	22	29	34	33	30	23	**n/a**
4	26	25	27	92	55	40	93	175	129	114	76	34	52	72	80	57	49	123	38	37	40	33	41	56	**65**
5	77	52	68	82	67	60	82	74	43	36	47	49	48	49	70	117	47	115	29	20	50	37	36	68	**59**
6	29	33	23	35	43	26	49	128	63	63	74	87	76	40	103	95	127	80	66	52	82	50	28	15	**61**
7	25	16	21	58	68	75	46	23	17	18	20	28	43	33	36	211	83	126	90	56	59	17	18	49	**51**
8	38	23	14	25	50	59	40	74	34	36	22	28	42	67	45	39	52	28	57	36	35	58	56	74	**43**
9	97	60	37	29	58	54	85	90	60	59	48	44	40	34	36	37	33	78	21	16	19	24	15	11	**45**
10	14	20	48	66	56	58	81	145	113	97	69	30	51	70	60	47	54	48	35	35	31	41	23	43	**56**
11	32	66	71	64	42	58	66	85	62	61	87	95	233	94	74	63	46	38	38	52	39	40	35	34	**66**
12	38	30	26	21	31	32	45	46	41	37	25	19	19	21	30	43	49	30	32	71	66	23	16	8	**33**
13	21	13	45	66	65	64	45	43	42	51	34	86	39	34	37	28	44	50	27	68	40	50	48	33	**45**
14	67	65	27	25	36	32	23	42	43	65	39	35	64	75	35	47	31	46	28	10	15	6	20	15	**37**
15	13	9	22	19	11	31	78	52	33	23	23	27	27	20	15	18	17	19	23	20	24	27	21	27	**25**
16	19	25	30	18	15	25	14	16	15	15	17	22	42	28	36	28	24	14	29	22	17	n/a	15	46	**23**
17	45	8	22	55	18	22	29	37	29	91	41	27	24	61	35	67	41	15	8	8	3	4	3	2	**29**
18	8	13	23	9	11	12	20	20	20	26	37	28	56	86	88	62	38	19	12	16	11	17	19	17	**28**
19	5	7	6	6	8	13	26	31	24	49	33	25	23	27	29	27	38	32	24	32	13	13	21	52	**23**
20	51	28	21	21	24	16	46	105	72	29	59	103	106	59	41	[illegible]	39	46	30	34	36	23	33	18	**44**
21	24	23	32	26	31	35	60	62	15	28	27	38	9	68	16	46	25	16	14	14	12	13	25	29	**29**
22	27	22	23	25	25	31	15	36	26	40	38	12	6	4	25	15	21	7	12	8	9	10	20	19	**20**
23	25	31	21	14	24	23	26	29	39	60	40	34	16	30	30	25	16	24	31	13	11	23	29	21	**26**
24	21	17	18	21	19	9	44	63	60	23	43	28	25	30	40	40	21	20	17	12	10	4	12	9	**25**
25	14	26	39	22	32	26	33	25	20	13	42	39	36	34	29	52	41	37	23	34	33	23	12	12	**29**
26	27	10	12	13	43	46	46	61	49	40	14	9	14	29	33	49	16	16	12	23	15	14	10	13	**25**
27	34	41	36	23	23	31	66	118	109	79	48	20	32	53	78	62	55	37	24	12	23	14	30	52	**46**
28	29	21	22	43	57	67	95	131	63	37	29	28	37	110	103	43	2	14	12	9	4	2	2	4	**40**
29	4	2	2	5	4	6	7	27	10	14	13	18	26	24	33	20	20	7	11	11	7	7	10	10	**12**
30	36	28	15	18	34	27	48	54	48	39	24	16	5	24	17	28	20	10	7	8	40	25	7	18	**25**
31	21	25	25	27	48	44	57	84	102	48	20	9	20	23	34	26	17	27	16	15	40	11	21	50	**34**

n/a Data not available due to instrument malfunction.

* **The TEOM head was changed from $PM_{2.5}$ to PM_{10} at 1500 on July 3.**

Data in *italics* is $PM_{2.5}$.

August 2001 Particulate (PM_{10}) Data ($\mu g/m^3$)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-hour Average
1	35	38	40	16	14	16	31	55	155	140	70	33	43	59	46	31	35	17	25	33	24	45	24	25	44
2	59	67	46	48	39	55	80	134	112	91	50	69	46	63	66	59	40	34	18	17	15	36	15	23	53
3	31	45	36	58	37	43	67	68	78	77	79	55	55	75	35	87	158	101	18	15	30	22	122	26	59
4	23	42	14	33	53	29	39	31	29	n/a	22	21	44	32	14	11	8	11	7	21	49	24	31	11	26
5	2	8	4	15	21	38	42	60	52	7	10	11	9	14	8	16	20	9	9	11	16	18	24	15	18
6	26	8	11	10	3	6	18	9	12	34	45	42	46	29	19	39	70	68	37	21	19	28	16	20	26
7	23	17	30	29	43	55	49	41	33	34	40	37	48	73	50	45	56	46	46	28	33	23	28	29	39
8	34	n/a	n/a	n/a	n/a	15	14	8	15	11	9	9	14	10	8	12	13	20	19	28	14	15	21	29	16
9	25	16	39	32	43	35	37	84	61	59	26	24	25	20	26	17	13	9	12	14	24	44	17	15	30
10	13	26	51	71	91	84	132	117	53	64	41	24	37	41	39	35	32	45	25	30	30	40	41	41	50
11	32	46	83	68	63	66	87	92	87	84	37	2	10	13	24	34	35	30	28	37	39	47	53	56	48
12	66	55	59	68	65	67	122	137	114	103	51	55	8	31	37	71	77	31	43	28	27	19	45	68	60
13	71	111	86	73	66	81	124	179	137	126	138	161	114	95	80	77	80	47	28	56	55	183	24	11	92
14	21	38	57	59	65	69	156	259	168	75	42	30	14	38	42	49	59	60	41	16	54	36	35	12	62
15	11	26	55	62	65	55	96	178	226	152	165	23	40	39	35	40	57	44	28	51	39	36	19	24	65
16	74	72	66	71	75	58	243	226	185	108	62	43	28	24	31	32	34	31	24	29	41	39	61	44	71
17	46	75	74	63	63	62	139	253	290	139	131	67	60	52	58	101	83	63	216	51	31	40	31	121	96
18	84	100	93	105	82	66	102	281	311	218	60	21	114	45	46	29	82	43	28	24	95	61	45	35	90
19	21	4	45	59	43	26	100	22	16	11	11	n/a	32	105	104	106	110	73	96	85	52	62	48	44	55
20	20	42	50	51	39	49	82	109	109	60	41	75	66	72	70	73	86	76	74	57	48	73	31	35	62
21	66	52	77	35	37	35	91	149	154	120	123	118	99	60	85	65	50	84	74	82	41	66	47	60	78
22	73	85	84	130	146	154	170	335	218	127	103	152	117	119	74	121	72	36	33	73	63	41	21	26	107
23	54	60	90	34	78	146	94	38	46	46	38	73	50	32	41	54	25	9	8	7	4	n/a	20	22	46
24	n/a	n/a	4	4	22	48	38	59	109	166	84	66	83	139	89	122	104	105	47	80	60	33	10	9	67
25	4	8	19	26	23	31	134	114	42	21	44	54	66	43	62	54	51	74	43	34	21	20	23	49	44
26	46	28	22	40	44	15	41	140	134	137	33	8	21	25	10	9	14	26	27	19	9	47	17	33	39
27	30	34	48	40	42	25	44	133	108	65	68	18	44	29	36	51	57	59	30	42	86	71	64	55	53
28	55	24	29	26	31	25	55	91	68	37	23	24	19	22	30	41	38	72	37	33	33	41	49	42	39
29	25	26	21	27	42	34	89	84	64	55	43	11	14	29	49	47	43	35	42	35	44	53	53	54	42
30	46	48	65	48	42	45	124	116	109	104	55	43	35	24	37	50	62	52	34	43	17	33	34	27	54
31	36	43	56	48	29	42	82	189	176	125	73	157	68	48	163	168	131	79	30	13	31	12	23	38	77

n/a Data not available due to instrument malfunction.